

حمل الآن

مجانا وحصريا

المراجعة رقم (1)

الترم الاول



Chapter 1

Chemical calculations

Atom

It is the smallest building unit of matter which participates in chemical reactions.

Molecule

It is the smallest fundamental part of matter which can exist solely, and retain the properties of this matter.

Molar mass

The mass of one atom is called atomic mass, which is a very small amount, it is estimated in a unit known as atomic mass unit amu which can be shortened to u

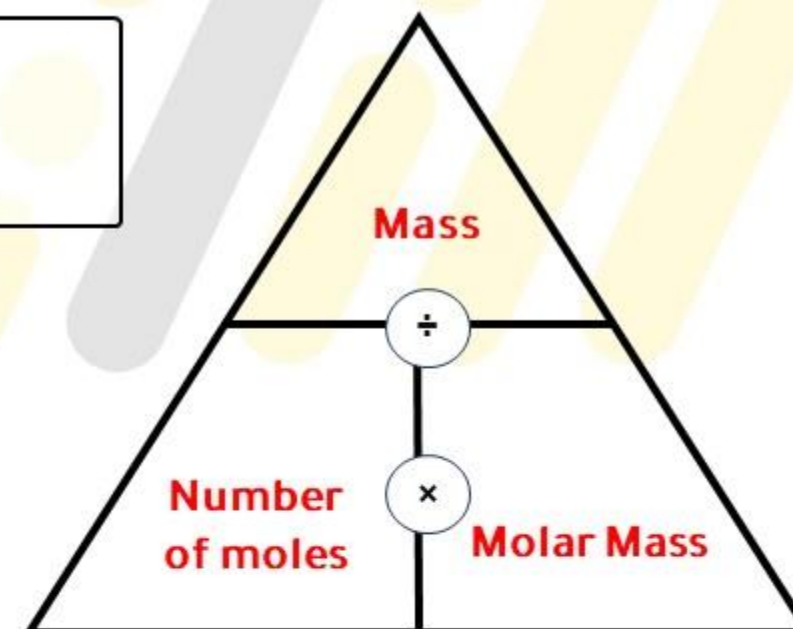
When the atomic mass of an element is estimated in grams, it is called the molar mass of atom, it is estimated in (g/mol)

The mole

It represents the amounts of chemical substances in the international system of units (SI), where it is equivalent to the amount of a substance which contains the same number of units (atoms, ions, molecules or formula units)

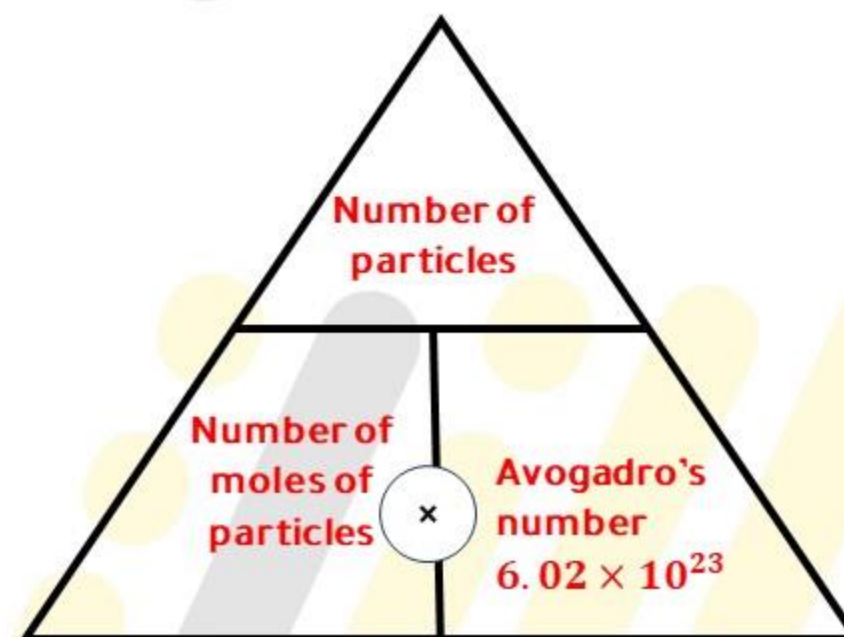
Calculation of the number of moles

$$\text{Number of moles (mol)} = \frac{\text{Mass of substance (g)}}{\text{Molar mass (mass of one mole) (g/mol)}}$$



Calculation of the number of moles

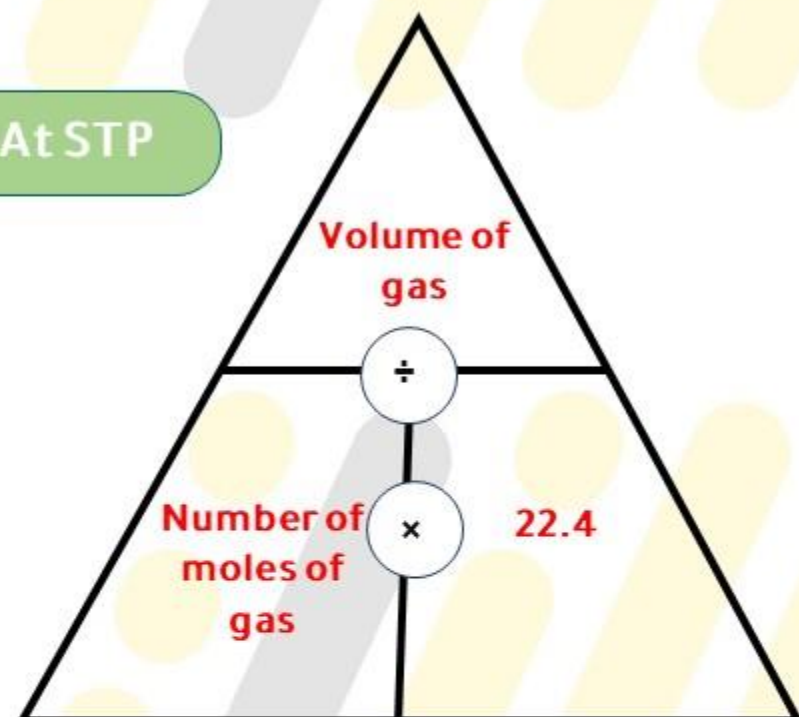
$$\text{Number of} = \text{Number of moles of} \times \text{Avogadro's number}$$



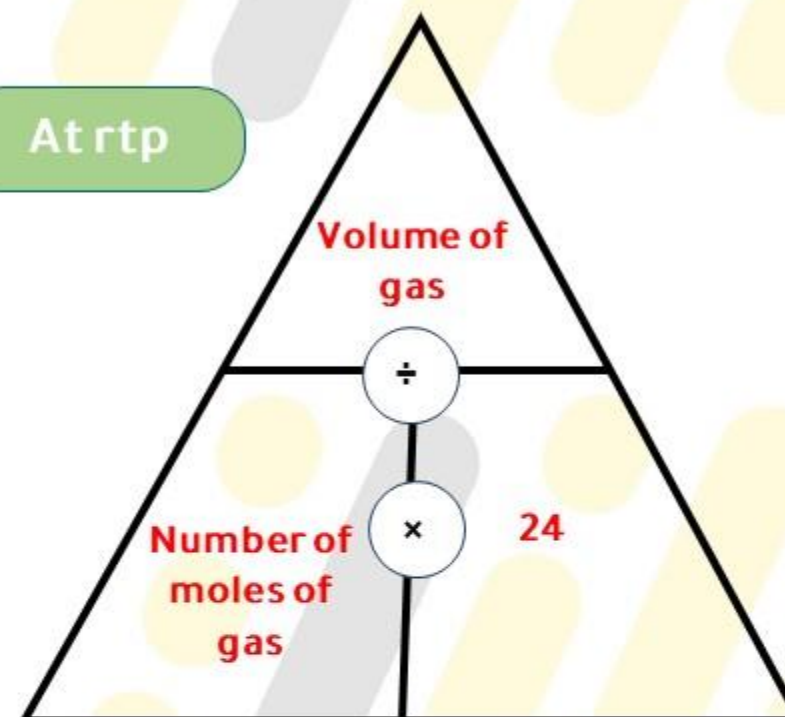
Avogadro's postulate

This postulate states that equal volumes of different gases - at the same conditions of temperature and pressure - contain equal numbers of molecules.

At STP



At rtp



Dilution of solutions

The amount of water required to be added to a known volume of a solution of known concentration, for this concentration to be changed by a certain extent, is calculated from the relation :

$$\text{Solution concentration } M_1 \times \text{Volume } V_1 = \text{Solution concentration } M_2 \times \text{Volume } V_2$$

(Before dilution) (After dilution)

Calculation of the chemical formula

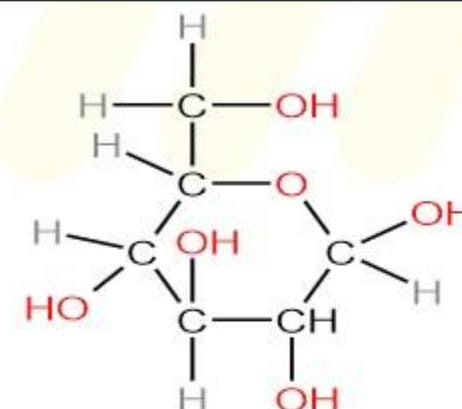
Empirical formula

Is the chemical formula which represents the simplest integer numerical ratio of the atoms or ions of the elements composing the compound CH₂O

Molecular formula

Is a chemical formula which represents the types and the numbers of the atoms or ions which compose the molecule (or the formula unit) of the compound C₆H₁₂O₆

Structural formula



Example

5 mol of potassium nitrate decomposes by heat as follows :



Calculate the volume of oxygen gas produced at : rtp

Answer:

$$\text{Number of } O_2 \text{ moles} = \frac{5}{2} = 2.5 \text{ mol}$$

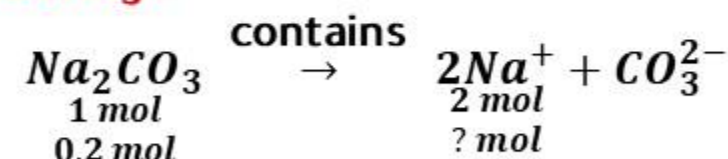
$$\text{Volume of } O_2 \text{ gas (at rtp)} = 2.5 \times 24 = 60 \text{ L}$$

Example

What is the number of sodium ions in 0.2 mol of sodium carbonate Na₂CO₃?

- (a) 0.2 ion.
- (b) 0.4 ion.
- (c) 2.408×10^{23} ions.
- (d) 1.204×10^{23} ions.

Idea of answering :



$$\begin{aligned} \text{Number of moles of sodium ions } Na^+ &= 2 \times 0.2 \\ &= 0.4 \text{ mol} \end{aligned}$$

Number of sodium ions Na^+ = Number of moles of ions × Avogadro's number

$$= 0.4 \times 6.02 \times 10^{23} = 2.408 \times 10^{23} \text{ ions}$$

Answer : The correct choice is (c)

Example

Calculate the volume which is occupied by 1.6 g of methane gas CH_4 at:

- (1) STP
- (2) rtp
- [C = 12, H = 1]

Answer:

Molar mass of $CH_4 = 12 + (4 \times 1) = 16 \text{ g/mol}$

Number of CH_4 moles = $\frac{\text{Mass}}{\text{Molar mass}} = \frac{1.6}{16} = 0.1 \text{ mol}$

(1) The volume of gas (at STP) = $0.1 \times 22.4 = 2.24 \text{ L}$

(2) The volume of gas (at rtp) = $0.1 \times 24 = 2.4 \text{ L}$

Example

Calculate the number of moles of sodium hydroxide found in 120 g of it.

[Na = 23, O = 16, H = 1]

Answer :

The molar mass of NaOH = $23 + 16 + 1 = 40 \text{ g/mol}$

The number of moles of NaOH = $\frac{\text{Mass of NaOH}}{\text{Molar mass of NaOH}}$
 $= \frac{120}{40} = 3 \text{ mol}$

Example

10 g of water vapour are passed on 16.8 g of iron which is heated till redness, according to the reaction : $3Fe_{(s)} + 4H_2O_{(v)} \xrightarrow{\Delta} Fe_3O_{4(s)} + 4H_{2(g)}$

Which of the following represents the limiting reactant and the produced amount of Fe_3O_4 respectively?

[Fe = 55.9, H = 1, O = 16]

(a) $H_2O/0.9 \text{ mol}$

(b) Fe/0.9 mol

(c) Fe/0.1 mol

(d) $H_2O/0.1 \text{ mol}$

Idea of answering :

Molar mass of $H_2O = (1 \times 2) + 16 = 18 \text{ g/mol}$

Number of moles = $\frac{\text{Mass}}{\text{Molar mass}}$

Number of given moles of $H_2O = \frac{10}{18} = 0.56 \text{ mol}$

Number of given moles of Fe = $\frac{16.8}{55.9} = 0.3 \text{ mol}$

Ratio of H_2O moles = $\frac{0.56}{4} = 0.14$

Ratio of Fe moles = $\frac{0.3}{3} = 0.1$

$\therefore$ The ratio of Fe moles is the least.

$\therefore$ Iron is the limiting reactant

$\therefore$ The choices (a) and (d) are excluded.

$\therefore$ Produced amount of $Fe_3O_4 = \frac{0.3}{3} = 0.1 \text{ mol}$

Answer : The correct choice is (c)

Chapter 2

Atomic Structure

Atomic model	Rutherford's	Bohr's	Modern atomic theory
Atom	* Contains a vast space (not solid). * Electrically neutral.	* Contains a vast space (not solid). * Electrically neutral. * Planar.	* Contains a vast space (not solid). * Electrically neutral.
Nucleus	* Positively charged. * Much smaller than the atom. * Most of the mass of the atom is contained in it.	* Positively charged. * Much smaller than the atom. * Most of the mass of the atom is contained in it.	* Positively charged. * Much smaller than the atom. * Most of the mass of the atom is contained in it.
Electrons	* Negatively charged particles, and their total negative charge equals the positive charge of the nucleus. * They move around the nucleus at tremendous speeds in special orbits. * Their mass is negligible compared to that of the nucleus.	* Negatively charged material particles (no wave properties yet). * They orbit the nucleus in definite orbits, and can not be found in the spaces between these orbits (forbidden regions). * The energy of the electron increases as the distance from the nucleus (the radius of its energy level) increases. * When an electron gains a quantum of energy, it jumps to a higher energy level, and the stable atom becomes excited.	* Material particles having wave properties (Dual nature of the electron). * It is not possible practically to determine both the velocity of an electron and its position at the same time, so this is described as probability distribution (uncertainty principle). * The region around the nucleus in which the electron probably exists in all dimensions is called the electron cloud. * The three dimensional region of space that indicates where there is a high probability of finding an electron is known as the orbital.
Additional information	* This theory could not elucidate the system of revolving the electrons around the nucleus.	* This theory could not explain the line spectrum of any element atom other than hydrogen atom.	

Worked Example

Two electrons in the same atom lie in the second orbital of the same sublevel p in the same principal level M . Write the four quantum numbers of the two electrons.

Idea of answering:

- ∴ The principal level is M
- ∴ The principal quantum number (n) of each of them is 3
- ∴ The sublevel is p
- ∴ The secondary (subsidiary) quantum number (l) of each of them is 1
- ∴ They both lie in the second orbital.
- ∴ The magnetic quantum number (m_l) of each of them is 0
- ∴ The two electrons in the same orbital are opposite in spin motion.
- ∴ The spin quantum number (m_s) of one of them is $\left(+\frac{1}{2}\right)$ and that of the other is $\left(-\frac{1}{2}\right)$.

Answer:

The four quantum numbers	n	l	m_l	m_s
First electron	3	1	0	$+\frac{1}{2}$
Second electron	3	1	0	$-\frac{1}{2}$

Summary of the quantum numbers

Quantum number	Principal (n)	Subsidiary (l)	Magnetic (m _l)	Spin (m _s)
Used in the determination of	* The order of the principal energy levels. * Their number in the heaviest known atom is 7". k L M N O P Q ↓ ↓ ↓ ↓ ↓ ↓ ↓ 1 2 3 4 5 6 7 * The number of the electrons required to saturate each principal energy levels (K to N) from the relation : $2n^2$	* Energy sublevels in each principal energy level. * Each principal energy level (n) contains a number of energy sublevels (l) that equals the numerical value of (n)". Sublevel Value of (l) S → 0 P → 1 D → 2 F → 3 (<i>ℓ</i>) values range between [0: (n - 1)]	* Number of the orbitals in each principal energy level (n) from the relation : n^2 n^2 Number of the orbitals in each energy sublevel (l) from the relation: $2\ell + 1$ * The spatial orientations of the orbitals. Each orbital is filled with 2 electrons (m_ℓ) values range between (-<i>ℓ</i>, 0, +<i>ℓ</i>)	* The direction of motion of the electron around its axis (spin motion): - Either clockwise (↑) its numerical value is $(+\frac{1}{2})$. - Or anticlockwise (↓) its numerical value is $(-\frac{1}{2})$.
Application	* The third principal energy level M becomes saturated with a number of electrons equals $2 \times 3^2 = 18e^-$	* The third principal energy level M consists of: Three energy sublevels which are : <i>s, p, d</i>	The third principal energy level M consists of number of orbitals equals $3^2 = 9$ Sublevel p whose value is 1 consists of a number of orbitals equals $(2 \times 1) + 1 = 3$	When the sublevel d contains 8 electrons, then the first electron in it will spin around its axis clockwise, and its (m_s) value will be $(+\frac{1}{2})$. ↑ While, the last electron in it will spin around its axis anticlockwise, and its (m_s) value will be $(-\frac{1}{2})$. ↑↓ ↑↓ ↑↓ ↑ ↑

Summary of the relations between the principal level, the sublevels and the orbitals

Symbol of the principal level	Principal quantum number (n)	The sublevels in each principal level	Secondary quantum number (l)	No. of the orbitals in each sublevel (2l+1)	No. of the orbitals in each principal level (n ²)	No. of the electrons required to saturate each principal level (2n ²)
K	1	1s	0	1	1	$2 \times 1 = 2e^-$
L	2	2s	0	1	4	$2 \times 4 = 8e^-$
		2p	1	3		
M	3	3s	0	1	9	$2 \times 9 = 18e^-$
		3p	1	3		
		3d	2	5		
N	4	4s	0	1	16	$2 \times 16 = 32e^-$
		4p	1	3		
		4d	2	5		
		4f	3	7		

Principle of distributing electrons



1 Pauli's exclusion principle

States that it is impossible for two electrons in the same atom to have the same four quantum numbers.

Application

The opposite table shows the two electrons of the (3s) sublevel which are **similar** in the values of the quantum numbers (n, ℓ, m_ℓ), but they are different in the two values of the spin quantum number (m_s).

The four quantum no.	n	ℓ	m_ℓ	m_s
The first electron	3	0	0	$+\frac{1}{2}$
The second electron	3	0	0	$-\frac{1}{2}$

2 Aufbau (building-up) principle

States that the electrons occupy the sublevels in the order of increasing their energy, the lowest energy sublevels are filled first.

- Arrangement of sublevels according to their energy depends on :
- Sum of ($n + \ell$).

Ex. Energy of 4s sublevel is lower than that of 3d sublevel... G.R. ?

Because the sum of ($n + \ell$) of 4s sublevel is less than that of 3d sublevel.

Order of the principal energy level.

"In case that the sum of ($n + \ell$) value is the same for the two sublevels".

Sequence of filling
energy sublevels

sublevels	sum of ($n + \ell$)
3p	$3+1=4$
4s	$4+0=4$
3d	$3+2=5$

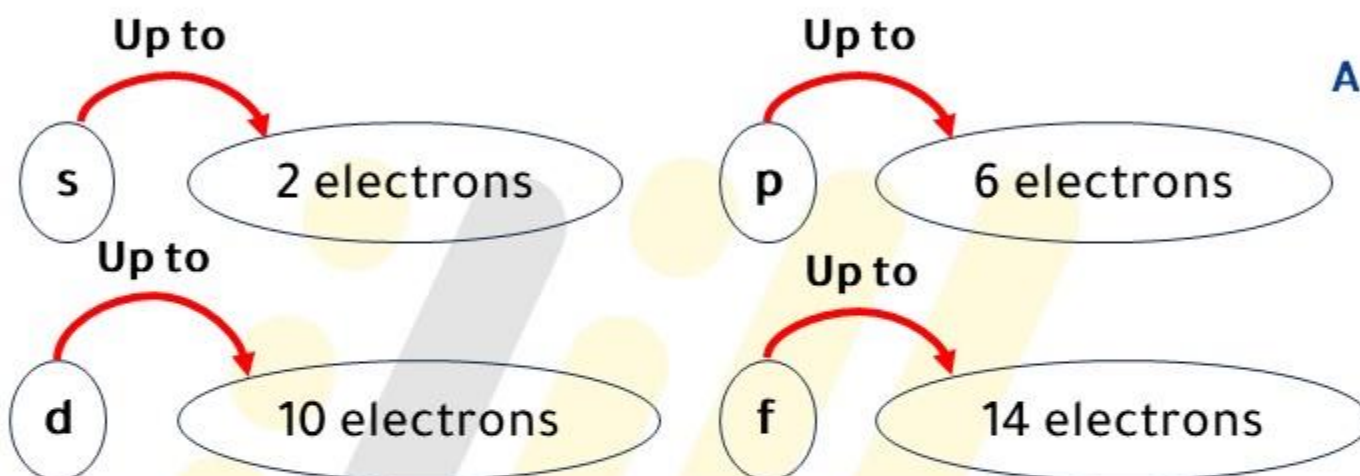
Ex. Energy of 3p sublevel is lower than that of 4s sublevel ... G.R.?

Because (n) value of 3p sublevel is lower than that of 4s sublevel.

- The sequence of energy sublevels is arranged ascendingly according to their energy following the order :

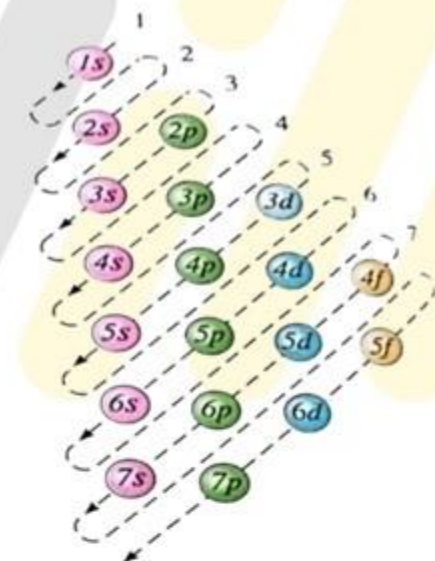
$$1s < 2s < 2p < 3s < 3p < 4s < 3d < 4p < 5s < 4d < 5p < 6s < 4f < 5d < 6p < 7s < 5f < 6d < 7p$$

- Filling the energy sublevels

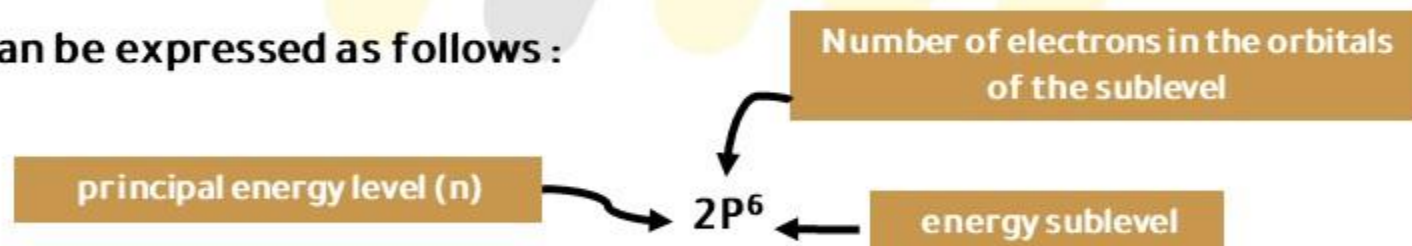


A simplified method of filling energy sublevels by following the direction of the arrows

Numbers 1: 8 represent the sum of (n + 1) of each sublevel



- The electronic configuration of an energy sublevel can be expressed as follows :



Example

Write the electronic configuration for the following elements, according to the building-up principle :

(1) $_{11}\text{Na}$ (2) $_{20}\text{Ca}$ (3) $_{32}\text{Ge}$

Answer:

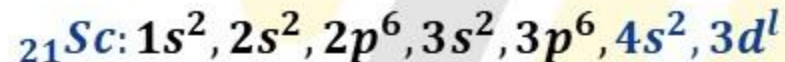
(1) $_{11}\text{Na}: 1s^2, 2s^2, 2p^6, 3s^1$

(2) $_{20}\text{Ca}: 1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2$

(3) $_{32}\text{Ge}: 1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2, 3d^{10}, 4p^2$

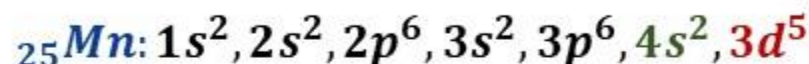
Notes

- The elements whose valence electrons are present in sublevels $(n)s, (n - l)d$ like :



tend during the chemical reactions to lose the electrons of the lower energy $(n)s$ sublevel (which is farther from the nucleus) first, then those of the higher energy $(n - 1)d$ sublevel (which is closer to the nucleus).

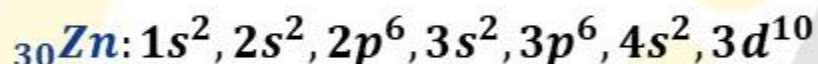
- It is clear in the electronic configuration of manganese element ${}_{25}\text{Mn}$ that :



- The farthest electron from the nucleus occupies the sublevel $4s$
- The last electron in the atom occupies the sublevel $3d$

Example

The electronic configuration of zinc atom ${}_{30}\text{Zn}$ is represented as follows:



Conclude the quantum numbers of :

- The last electron with the highest energy in the atom of this element.
- The farthest electron from the nucleus of the atom of this element.

Answer:

$$(1) n = 3, \ell = 2, m_\ell = +2, m_s = -\frac{1}{2} \quad 3d^{10} \quad \begin{array}{|c|c|c|c|c|} \hline \uparrow\downarrow & \uparrow\downarrow & \uparrow\downarrow & \uparrow\downarrow & \uparrow\downarrow \\ \hline \end{array}$$

$$(2) n = 4, \ell = 0, m_\ell = 0, m_s = -\frac{1}{2} \quad 4s^2 \quad \begin{array}{|c|} \hline \uparrow\downarrow \\ \hline \end{array}$$



States that no electron pairing takes place in a given sublevel until each orbital contains one electron.

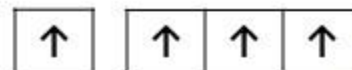
- Rules of filling the energy sublevels with electrons, according to Hund's rule :

Rules	Applications
The orbitals of the same sublevel are equal in their energy	2p The three 2p orbitals are equal in energy 3d The five 3d orbitals are equal in energy
The orbitals of the same sublevel are filled successively by the unpaired electrons firstly, the spinning of single electrons is in the same direction	p_x p^1 ↑ $p_x \quad p_y$ p^2 ↑ ↑ $p_x \quad p_y \quad p_z$ p^3 ↑ ↑ ↑ The successive filling of <i>p</i> orbitals with unpaired electrons first
Electron pairing takes place in the orbitals of the same sublevel after occupying all orbitals by the unpaired electrons first, and these paired electrons have opposite spin directions (being in a spin-paired state) *According to Pauli's exclusion principle*	2P⁴ ↑↓ ↑↓ 2S² ↑↓ 1S² ↑↓ ✗ 2P⁴ ↑↓ ↑ ↑ 2S² ↑↓ 1S² ↑↓ ✓ The electronic configuration of oxygen atom $_8\text{O}$
The electron prefers to be paired with another electron in one orbital of the same sublevel rather than being transferred to a higher energy sublevel	2P¹ ↑ 2S¹ ↑ 1S² ↑↓ ✗ 2S² ↑↓ 1S² ↑↓ ✓ The electronic configuration of beryllium atom $_4\text{Be}$ «According to Hund's rule»

Notes



The electronic distribution **obeys** Aufbau principle, but **violates** Pauli's exclusion principle



The electronic distribution **obeys** Pauli's exclusion principle, but **violates** Aufbau principle



The electronic distribution **obeys** both Aufbau principle, and Pauli's exclusion principle, but **violates** Hund's rule

Application

The electronic configuration of some elements according to building-up principle and Hund's rule :

Element	Atomic number	Electronic configuration according to building-up principle	Electronic configuration according to Hund's rule
Nitrogen ${}_7\text{N}$	7	$1s^2, 2s^2, 2p^3$	 $1s^2, 2s^2, 2p_x^1, 2p_y^1, 2p_z^1$
Fluorine ${}_9\text{F}$	9	$1s^2, 2s^2, 2p^5$	 $1s^2, 2s^2, 2p_x^2, 2p_y^2, 2p_z^1$
Neon ${}_{10}\text{Ne}$	10	$1s^2, 2s^2, 2p^6$	 $1s^2, 2s^2, 2p_x^2, 2p_y^2, 2p_z^2$

Example 1

Three elements (X), (Y) and (Z) :

Element (X) : Its principal energy level ($n = 3$) contains 3 electrons.

Element (Y) : Its last sublevel is $3s$ which is half filled with electrons.

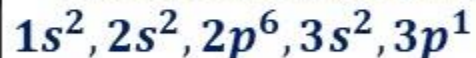
Element (Z) : Its electronic configuration is $1s^2, 2s^2, 2p^3$

Which of the following are the atomic numbers of (X), (Y) and (Z) ?

Choices	(X)	(Y)	(Z)
(a)	11	7	13
(b)	11	13	7
(c)	13	11	7
(d)	13	7	11

Idea of answering :

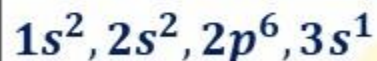
∴ The electronic configuration of element (X) is :



∴ The atomic number of element (X) = 13

∴ The choices (a) and (b) are excluded.

∴ The electronic configuration of element (Y) is :



∴ The atomic number of element (Y) = 11

∴ The choice (d) is excluded.

∴ The electronic configuration of element (Z) is : $1s^2, 2s^2, 2p^3$

∴ The atomic number of element (Z) = 7

Answer: The correct choice is (c)

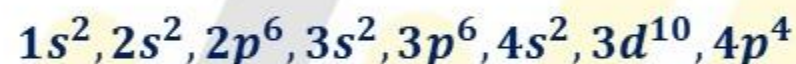
Example 2

An element (X) whose electrons are distributed in four principal energy levels, and its last energy level contains 6 electrons:

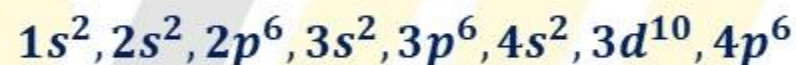
- (1) Write the full electronic configuration of the ion (X^{2-}).
- (2) What is the number of the unpaired electrons in the last sublevel in the atom of this element?
- (3) What are the quantum numbers of the last electron in the atom of this element ?

Answer:

(1) ∴ The full electronic configuration of the element atom (X) :



∴ The full electronic configuration of the ion (X^{2-}) :



(2) 2 unpaired electrons.

(3) $4p^4$

↑↓	↑	↑
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 $n = 4, l = 1, m_l = -1, m_s = -\frac{1}{2}$

Chapter 3

Periodic table

Periodic table with atomic number, symbol, and electron configuration

- Alkali metals
- Alkaline-earth metals
- Transition metals
- Other metals
- Other nonmetals
- Halogens
- Noble gases
- Rare-earth elements (21, 39, 57–71) and lanthanoid elements (57–71 only)
- Actinoid elements

period	group	1*	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1		1 H 1s ¹																	2 He 1s ²
2		3 Li [He]2s ¹	4 Be 2s ²											5 B 2s ² 2p ¹	6 C 2s ² 2p ²	7 N 2s ² 2p ³	8 O 2s ² 2p ⁴	9 F 2s ² 2p ⁵	10 Ne 2s ² 2p ⁶
3		11 Na [Ne]3s ¹	12 Mg 3s ²											13 Al 3s ² 3p ¹	14 Si 3s ² 3p ²	15 P 3s ² 3p ³	16 S 3s ² 3p ⁴	17 Cl 3s ² 3p ⁵	18 Ar 3s ² 3p ⁶
4		19 K [Ar]4s ¹	20 Ca 4s ²	21 Sc 3d ¹ 4s ²	22 Ti 3d ² 4s ²	23 V 3d ³ 4s ²	24 Cr 3d ⁵ 4s ¹	25 Mn 3d ⁵ 4s ²	26 Fe 3d ⁶ 4s ²	27 Co 3d ⁷ 4s ²	28 Ni 3d ⁸ 4s ²	29 Cu 3d ¹⁰ 4s ¹	30 Zn 3d ¹⁰ 4s ²	31 Ga 3d ¹⁰ 4s ² 4p ¹	32 Ge 3d ¹⁰ 4s ² 4p ²	33 As 3d ¹⁰ 4s ² 4p ³	34 Se 3d ¹⁰ 4s ² 4p ⁴	35 Br 3d ¹⁰ 4s ² 4p ⁵	36 Kr 3d ¹⁰ 4s ² 4p ⁶
5		37 Rb [Kr]5s ¹	38 Sr 5s ²	39 Y 4d ¹ 5s ²	40 Zr 4d ² 5s ²	41 Nb 4d ⁴ 5s ¹	42 Mo 4d ⁵ 5s ¹	43 Tc 4d ⁵ 5s ²	44 Ru 4d ⁷ 5s ¹	45 Rh 4d ⁸ 5s ¹	46 Pd 4d ¹⁰	47 Ag 4d ¹⁰ 5s ¹	48 Cd 4d ¹⁰ 5s ²	49 In 4d ¹⁰ 5s ² 5p ¹	50 Sn 4d ¹⁰ 5s ² 5p ²	51 Sb 4d ¹⁰ 5s ² 5p ³	52 Te 4d ¹⁰ 5s ² 5p ⁴	53 I 4d ¹⁰ 5s ² 5p ⁵	54 Xe 4d ¹⁰ 5s ² 5p ⁶
6		55 Cs [Xe]6s ¹	56 Ba 6s ²	57 La 5d ¹ 6s ²	72 Hf 4f ¹⁴ 5d ² 6s ²	73 Ta 4f ¹⁴ 5d ³ 6s ²	74 W 4f ¹⁴ 5d ⁴ 6s ²	75 Re 4f ¹⁴ 5d ⁵ 6s ²	76 Os 4f ¹⁴ 5d ⁶ 6s ²	77 Ir 4f ¹⁴ 5d ⁷ 6s ²	78 Pt 4f ¹⁴ 5d ⁹ 6s ¹	79 Au 4f ¹⁴ 5d ¹⁰ 6s ¹	80 Hg 4f ¹⁴ 5d ¹⁰ 6s ²	81 Tl 4f ¹⁴ 5d ¹⁰ 6s ² 6p ¹	82 Pb 4f ¹⁴ 5d ¹⁰ 6s ² 6p ²	83 Bi 4f ¹⁴ 5d ¹⁰ 6s ² 6p ³	84 Po 4f ¹⁴ 5d ¹⁰ 6s ² 6p ⁴	85 At 4f ¹⁴ 5d ¹⁰ 6s ² 6p ⁵	86 Rn 4f ¹⁴ 5d ¹⁰ 6s ² 6p ⁶
7		87 Fr [Rn]7s ¹	88 Ra 7s ²	89 Ac 6d ¹ 7s ²	104 Rf 5f ¹⁴ 6d ² 7s ²	105 Db 5f ¹⁴ 6d ³ 7s ²	106 Sg 5f ¹⁴ 6d ⁴ 7s ²	107 Bh 5f ¹⁴ 6d ⁵ 7s ²	108 Hs 5f ¹⁴ 6d ⁶ 7s ²	109 Mt 5f ¹⁴ 6d ⁷ 7s ²	110 Ds 5f ¹⁴ 6d ⁹ 7s ¹	111 Rg 5f ¹⁴ 6d ¹⁰ 7s ¹	112 Cn 5f ¹⁴ 6d ¹⁰ 7s ²	113 Nh 5f ¹⁴ 6d ¹⁰ 7s ² 7p ¹	114 Fl 5f ¹⁴ 6d ¹⁰ 7s ² 7p ²	115 Mc 5f ¹⁴ 6d ¹⁰ 7s ² 7p ³	116 Lv 5f ¹⁴ 6d ¹⁰ 7s ² 7p ⁴	117 Ts 5f ¹⁴ 6d ¹⁰ 7s ² 7p ⁵	118 Og 5f ¹⁴ 6d ¹⁰ 7s ² 7p ⁶

lanthanoid series 6

58 Ce [Xe]4f ¹ 6s ²	59 Pr 4f ³ 6s ²	60 Nd 4f ⁴ 6s ²	61 Pm 4f ⁵ 6s ²	62 Sm 4f ⁶ 6s ²	63 Eu 4f ⁷ 6s ²	64 Gd 4f ⁷ 5d ¹ 6s ²	65 Tb 4f ⁹ 6s ²	66 Dy 4f ¹⁰ 6s ²	67 Ho 4f ¹¹ 6s ²	68 Er 4f ¹² 6s ²	69 Tm 4f ¹³ 6s ²	70 Yb 4f ¹⁴ 6s ²	71 Lu 4f ¹⁴ 5d ¹ 6s ²
--	--	--	--	--	--	--	--	---	---	---	---	---	---

actinoid series 7

90 Th [Rn]6d ² 7s ²	91 Pa 5f ² 6d ¹ 7s ²	92 U 5f ³ 6d ¹ 7s ²	93 Np 5f ⁴ 6d ¹ 7s ²	94 Pu 5f ⁶ 7s ²	95 Am 5f ⁷ 7s ²	96 Cm 5f ⁷ 6d ¹ 7s ²	97 Bk 5f ⁹ 7s ²	98 Cf 5f ¹⁰ 7s ²	99 Es 5f ¹¹ 7s ²	100 Fm 5f ¹² 7s ²	101 Md 5f ¹³ 7s ²	102 No 5f ¹⁴ 7s ²	103 Lr 5f ¹⁴ 6d ¹ 7s ²
--	--	---	--	--	--	--	--	---	---	--	--	--	--

The modern periodic table

The modern periodic table consists - as shown on the previous page - of :

- 7 periods (horizontal rows).
- 18 groups (vertical columns).

The elements are arranged ascendingly according to :

- Their atomic numbers (number of protons).
- The sequence of filling energy sublevels

with electrons according to Aufbau (the building-up) principle, where each element has one more electron than the element which precedes it in the same period.

Each period begins by filling a new principal energy level with one electron, then filling the energy sublevels lying in the same principal energy level successively, until we reach the last element in the period which is a noble gas in which all the levels are completely filled with electrons.

Elements of the same group

- **Similar** in their chemical properties, as they are similar in the electronic configuration of the last level (the valence shell).
- **Different in** the principal quantum number (n) of this outermost energy level.

Elements of the same period

- **Different in** their chemical properties, as they are different in the electronic configuration of the last level (the valence shell).
 - **Similar in** the principal quantum number (n) of this outermost energy level.
- Test Yourself

The elements blocks of the modern periodic table

- The table is divided into four main blocks, these blocks are :

(1) s-block.

(2) p-block.

(3) d-block.

(4) f-block.



1

s-block elements

- They are placed in **the left side** of the table.
- The s-block contains the elements whose outermost electrons occupy the '**s**' sublevel «except ${}^4_2\text{He}$ »
- The s-block consists of **two groups** of elements, they are:
 - 1A** whose electronic configuration ends with **ns^1**
 - 2A** whose electronic configuration ends with **ns^2**
- Where '**n**' stands for the number of the outermost energy level as well as the number of the period.

1	1 [*]	2
1	¹ ₁ H	
2	³ ₃ Li	⁴ ₂ Be
3	¹¹ ₁₁ Na	¹² ₁₂ Mg
4	¹⁹ ₁₉ K	²⁰ ₂₀ Ca
5	³⁷ ₃₇ Rb	³⁸ ₃₈ Sr
6	⁵⁵ ₅₅ Cs	⁵⁶ ₅₆ Ba
7	⁸⁷ ₈₇ Fr	⁸⁸ ₈₈ Ra

The two groups of s-block

2

p-block elements

- They occupy **the right side** of the table.
- The p-block includes the elements whose outermost electrons occupy the '**p**' sublevel and their electronic configurations end with **$(ns^2, np^{1:6})$** , (except helium $1s^2$).
- The p-block consists of **six groups**, characterized by the letter '**A**' except '**group zero**', as follows :

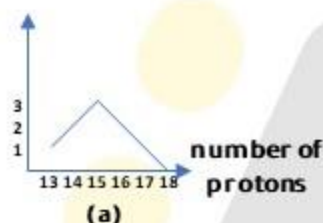
						2
						² ₂ He
5	6	7	8	9	10	
⁵ ₅ B	⁶ ₆ C	⁷ ₇ N	⁸ ₈ O	⁹ ₉ F	¹⁰ ₁₀ Ne	
13	14	15	16	17	18	
¹³ ₁₃ Al	¹⁴ ₁₄ Si	¹⁵ ₁₅ P	¹⁶ ₁₆ S	¹⁷ ₁₇ Cl	¹⁸ ₁₈ Ar	
31	32	33	34	35	36	
³¹ ₃₁ Ga	³² ₃₂ Ge	³³ ₃₃ As	³⁴ ₃₄ Se	³⁵ ₃₅ Br	³⁶ ₃₆ Kr	
49	50	51	52	53	54	
⁴⁹ ₄₉ In	⁵⁰ ₅₀ Sn	⁵¹ ₅₁ Sb	⁵² ₅₂ Te	⁵³ ₅₃ I	⁵⁴ ₅₄ Xe	
81	82	83	84	85	86	
⁸¹ ₈₁ Tl	⁸² ₈₂ Pb	⁸³ ₈₃ Bi	⁸⁴ ₈₄ Po	⁸⁵ ₈₅ At	⁸⁶ ₈₆ Rn	

The groups of p-block

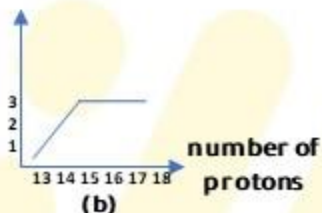
Test Yourself

Which of the following graphical figures represents the number of the unpaired electrons in the orbitals of 3p sublevel of some elements of the third period in the periodic table?

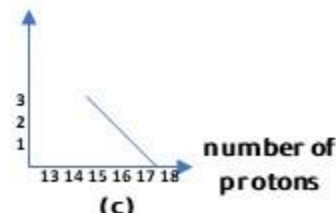
number of the unpaired electrons in the orbitals of 3p



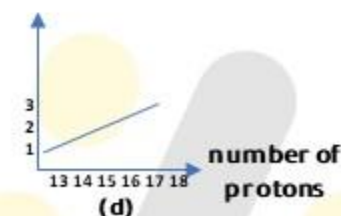
number of the unpaired electrons in 3p



number of the unpaired electrons in 3p



number of the unpaired electrons in 3p



Answer: The correct choice is (a)

- They occupy **the middle** of the table.
- The d-block contains the elements in which the "**d**" sublevel is filled successively by electrons and their electronic configurations end with (**$ns^{1:2}, (n-1)d^{1:10}$**).
- The d-block consists of "**10**" vertical columns representing "**8**" groups which are characterized by the symbol "**B**" except eighth group (VIII) which consists of "**3**" vertical columns.
- The d-block elements are classified according to the number of the outermost energy level and the period number into 4 series (each contains **10** elements), among them are :

21 Sc $3d^1 4s^2$	22 Ti $3d^2 4s^2$	23 V $3d^3 4s^2$	24 Cr $3d^5 4s^1$	25 Mn $3d^5 4s^2$	26 Fe $3d^6 4s^2$	27 Co $3d^7 4s^2$	28 Ni $3d^8 4s^2$	29 Cu $3d^{10} 4s^1$	30 Zn $3d^{10} 4s^2$
39 Y $4d^1 5s^2$	40 Zr $4d^2 5s^2$	41 Nb $4d^4 5s^1$	42 Mo $4d^5 5s^1$	43 Tc $4d^5 5s^2$	44 Ru $4d^7 5s^1$	45 Rh $4d^8 5s^1$	46 Pd $4d^{10}$	47 Ag $4d^{10} 5s^1$	48 Cd $4d^{10} 5s^2$
57 La $5d^1 6s^2$	72 Hf $4f^{14} 5d^2 6s^2$	73 Ta $4f^{14} 5d^3 6s^2$	74 W $4f^{14} 5d^4 6s^2$	75 Re $4f^{14} 5d^5 6s^2$	76 Os $4f^{14} 5d^6 6s^2$	77 Ir $4f^{14} 5d^7 6s^2$	78 Pt $4f^{14} 5d^9 6s^1$	79 Au $4f^{14} 5d^{10} 6s^1$	80 Hg $4f^{14} 5d^{10} 6s^2$

The groups of d-block

1) The first transition series:

- It includes the elements in which the "**3d**" sublevel is filled successively.
- It lies in **the fourth period** and includes the elements from scandium ($_{21}\text{Sc}$) to zinc ($_{30}\text{Zn}$).

2) The second transition series:

- It includes the elements in which the "**4d**" sublevel is filled successively.
- It lies in **the fifth period** and includes the elements from yttrium ($_{39}\text{Y}$) to cadmium ($_{48}\text{Cd}$).

3) The third transition series:

- It includes the elements in which the "**5d**" sublevel is filled successively.
- It lies in **the sixth period** and includes the elements from lanthanum ($_{57}\text{La}$) to mercury ($_{80}\text{Hg}$).

Test yourself

Which quantum numbers represent the electrons of the last sublevel that is filled successively in the elements $_{21}\text{Sc}$ to $_{30}\text{Zn}$?

- (a) $n = 3, l = 1$ (b) $n = 3, l = 2$ (c) $n = 4, l = 1$ (d) $n = 4, l = 2$

Idea of answering:

$\therefore$ The elements from $_{21}\text{Sc}$ to $_{30}\text{Zn}$ are the elements of the 1st transition series which lies in the 4th period, in this series the sublevel 3d is successively filled with electrons.

$\therefore n = 3 \quad l = 2$

Answer: The correct choice is (b)

4 f-block elements

- They are **separated down** the table, to avoid being too long.
- In this block the "**f**" sublevel is filled successively.
- The f-block is divided into **two series** (each contains **14** elements), which are :

lanthanoid series 6

58 Ce [Xe]4f²6s²	59 Pr 4f³6s²	60 Nd 4f⁴6s²	61 Pm 4f⁵6s²	62 Sm 4f⁶6s²	63 Eu 4f⁷6s²	64 Gd 4f⁷5d¹6s²	65 Tb 4f⁹6s²	66 Dy 4f¹⁰6s²	67 Ho 4f¹¹6s²	68 Er 4f¹²6s²	69 Tm 4f¹³6s²	70 Yb 4f¹⁴6s²	71 Lu 4f¹⁴5d¹6s²
90 Th [Rn]6d²7s²	91 Pa 5f²6d¹7s²	92 U 5f³6d¹7s²	93 Np 5f⁴6d¹7s²	94 Pu 5f⁶7s²	95 Am 5f⁷7s²	96 Cm 5f⁷6d¹7s²	97 Bk 5f⁹7s²	98 Cf 5f¹⁰7s²	99 Es 5f¹¹7s²	100 Fm 5f¹²7s²	101 Md 5f¹³7s²	102 No 5f¹⁴7s²	103 Lr 5f¹⁴6d¹7s²

The two series of f-block

1) The lanthanides series:

- It is placed in **the sixth period**, in which the "**4f**" sublevel is filled successively, it includes 14 elements.
- The elements of this series were named - inaccurately - by **rare earths** .. G.R. ?
Because they are quite similar in behavior and very difficult to be separated from each other as the outermost energy level for all of them is **6s²**
However, that name is not accurate, as recently their oxides could be separated by ionic exchange.

The types of the periodic table elements

It is possible to classify the elements in the periodic table into four types, which are.

1) Noble gases

- They are the elements of **group zero "18"** which is the last column of **p-block**.
- They are characterized by having energy levels completely filled with electrons and their electronic configurations end with **np^6** , except that of helium ${}_2\text{He}$ which ends with **$1s^2$**

2	He
10	Ne
18	Ar
36	Kr
54	Xe
86	Rn

Noble gases

2) The representative elements

- They are the elements of **s** and **p-blocks**, except that of group zero.
- They occupy the groups from **1A:7A**
- These elements are characterized by the complete filling of all the energy levels with electrons, **except for the outermost level**.
- They are active elements.. G.R. ? Because their outermost energy level tends to reach the completed electronic configuration similar to that of the nearest noble gas (**$1s^2$** or **ns^2, np^6**) by gaining, losing or sharing electrons.

5A (15)	6A (16)	7A (17)	8A (18)	1A (1)	2A (2)	3A (13)
N ³⁻	O ²⁻	F ⁻	He	Li ⁺		Al ³⁺
			Ne	Na ⁺	Mg ²⁺	
S ²⁻	Cl ⁻		Ar	K ⁺	Ca ²⁺	
		Br ⁻	Kr	Rb ⁺	Sr ²⁺	
		I ⁻	Xe	Cs ⁺	Ba ²⁺	

The representative elements tend to reach the electron configuration of the nearest noble gas

3) The main transition elements

- They are the elements of **the d-block**.
- They are characterized by having energy levels completely filled with electrons, except **the outermost two levels**.

Examples: $21^{Sc}: 1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2, 3d^1$

- In the principal level ($n = 4$) : The sublevel $4p$ is vacant.
- In the principal level ($n = 3$) : The sublevel $3d$ is incompletely filled.

Transition elements will be thoroughly discussed next year

4) The inner transition elements

- They are the elements of **the f-block**.
- They are characterized by having energy levels completely filled with electrons, except **the outermost three levels**.

Examples: $64^{Gd}: 1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2, 3d^{10}, 4p^6, 5s^2, 4d^{10}, 5p^6, 6s^2, 4f^7, 5d^1$

- In the principal level ($n = 4$) : The sublevel **4f** is incompletely filled.
- In the principal level ($n = 5$) : The sublevel **5d** is incompletely filled.
- In the principal level ($n = 6$) : The sublevel **6p** is vacant.

The anomaly of the electron configurations of some elements in the periodic table

Chromium element ($_{24}\text{Cr}$)

Copper element ($_{29}\text{Cu}$)

Hypothetical electron configuration

$_{24}\text{Cr}: [\text{Ar}], 4s^2, 3d^4$

$_{29}\text{Cu}: [\text{Ar}], 4s^2, 3d^9$

Actual electron configuration

$_{24}\text{Cr}: [\text{Ar}], 4s^1, 3d^5$

$_{29}\text{Cu}: [\text{Ar}], 4s^1, 3d^{10}$

Explanation

The atom becomes more stable when the d sublevel is:

Half filled

$3d^5$

↑	↑	↑	↑	↑
---	---	---	---	---

Or

Completely filled

$3d^{10}$

↑↓	↑↓	↑↓	↑↓	↑↓
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- By the same way the electronic configuration of both molybdenum ($_{42}\text{Mo}$) and gadolinium ($_{64}\text{Gd}$)

Test Yourself

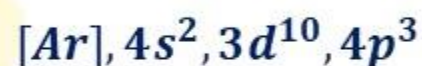
Two elements (X) and (Z) are located in group 5 A, if the element (X) is located in the third period, and the element (Z) is located in the fifth period.

What is the atomic number of the element (Y) which lies between them in the same group?

- (a) 31
- (b) 32
- (c) 33
- (d) 34

Idea of answering:

- ∴ Element (X) is located in the third period, and element (Z) in the fifth period.
- ∴ Element (Y) is located in the 4th period.
- ∴ The electronic configuration of the atom of this element is:



- ∴ The atomic number of element (Y) = $18 + 2 + 10 + 3 = 33$

Answer: The correct choice is C

The graduation of the representative elements properties

1

The atomic radius

- The concept of bond length in the covalent compounds differs from that in the ionic compounds.
- By knowing the bond length, we can calculate:

- A) Atomic radius.
- B) Ionic radius.

A

Atomic radius

- The atomic radius cannot be estimated or measured physically by the distance between the nucleus and the farthest electron ... G.R.?

Because it is impossible to determine the precise location of an electron around the nucleus (as the wave mechanics theory revealed).

But the atomic radius can be calculated by knowing **the covalent bond length which is estimated in angstroms (Å)**.

Covalent bond length = Sum of the two atomic radii of the two atoms of the molecule

$$\text{The atomic radius } (r) = \frac{\text{Bond length in a diatomic element molecule } (2r)}{2}$$

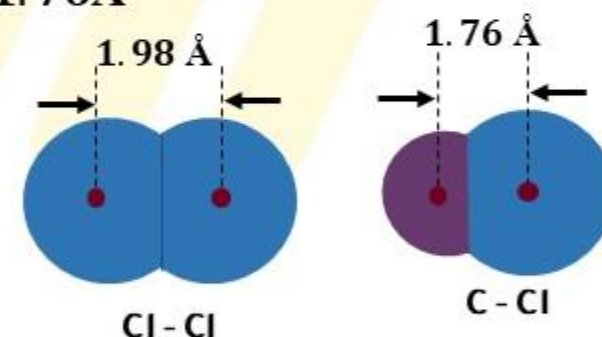
Worked Examples

1) If you know that:

- The bond length in chlorine molecule Cl_2 is 1.98Å
- The bond length between carbon and chlorine atoms (C-Cl) in carbon tetrachloride CCl_4 is 1.76Å

What is the atomic radius of carbon atom?

- (a) 0.22Å
- (b) 0.77Å
- (c) 0.99Å
- (d) 1.21Å



Idea of answering :

$$\text{The atomic radius of chlorine} = \frac{\text{Bond length in chlorine molecule } \text{Cl}_2}{2} \quad r(\text{Cl}) = \frac{1.98}{2} = 0.99\text{Å}$$

The atomic radius of carbon = The (C – Cl) bond length - The atomic radius of chlorine

$$r(\text{C}) = 1.76 - 0.99 = 0.77\text{Å}$$

Answer: The correct choice is (b)

- 2) • The bond length in hydrogen molecule $H_2 = 0.6 \text{ \AA}$
 • The bond length in oxygen molecule $O_2 = 1.32 \text{ \AA}$
 • The bond length in nitric oxide molecule $NO = 1.36 \text{ \AA}$

Calculate :

- (1) The bond length in nitrogen molecule N_2
 (2) The bond length (N – H) in ammonia molecule NH_3

Answer:

- (1) The atomic radius of oxygen = $\frac{\text{Bond length of } O_2 \text{ molecule}}{2}$

$$r(O) = \frac{1.32}{2} = 0.66 \text{ \AA}$$

The atomic radius of nitrogen = The (N – O) bond length - The atomic radius of oxygen $r(N) = 1.36 - 0.66 = 0.7 \text{ \AA}$

The bond length in nitrogen molecule $N_2 = 2 \times$ The atomic radius of nitrogen $2r(N_2) = 2 \times 0.7 = 1.4 \text{ \AA}$

- (2) The atomic radius of hydrogen = $\frac{\text{Bond length of } H_2 \text{ molecule}}{2}$ $r(H) = \frac{0.6}{2} = 0.3 \text{ \AA}$

The bond length (N – H) = The atomic radius of nitrogen + The atomic radius of hydrogen $r(N) + r(H) = 0.7 + 0.3 = 1 \text{ \AA}$

B

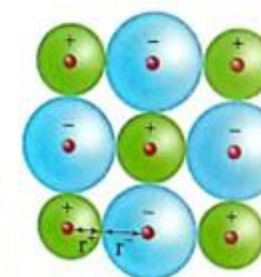
Ionic radius

B) Ionic radius

Ionic bond length is estimated by the distance between the centers of the nuclei of two bonded ions in the formula unit of the crystal.

The ionic bond length = The sum of two ionic radii in the formula unit

- The ionic radius depends on the number of electrons lost or gained to form ions.



Ionic bond length sum of the radii of (cation + anion)

Worked Example

- The ionic radius of lithium (Li^+) = $0.68\text{\AA}$
- The ionic radius of sodium (Na^+) = $0.98\text{\AA}$
- The bond length of sodium chloride formula unit (Na^+Cl^-) = $2.76\text{\AA}$

What is the ionic bond length in lithium chloride formula unit?

- (a) $1.66\text{\AA}$ (b) $1.78\text{\AA}$ (c) $2.08\text{\AA}$ (d) $2.46\text{\AA}$

Idea of answering :

- The ionic radius of chloride ion Cl^- = The (Na^+Cl^-) bond length - The ionic radius of sodium $r(\text{Cl}^-) = 2.76 - 0.98 = 1.78\text{\AA}$
- The bond length in lithium chloride formula unit (Li^+Cl^-) = The ionic radius of lithium ion + The ionic radius of chloride ion

$$r(\text{Li}^+) + r(\text{Cl}^-) = 0.68 + 1.78 = 2.46\text{\AA}$$

Answer: The correct choice is (d)

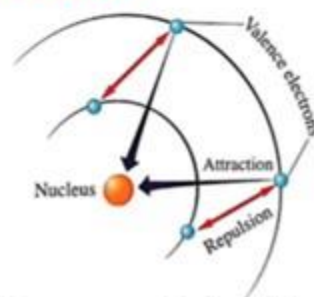
The effective nuclear charge concept (Z-effect)

- The valence electrons are not affected by the complete nuclear charge (the charge of the nucleus protons).
- This is because the inner electrons (core electrons of the inner completely filled energy levels) screen a part of this charge from the valence electrons (electrons of interest). Hence, the actual charge affecting any electron is called

the effective nuclear charge (Z_{eff})

which is the actual nuclear charge (positive charge) that affects an electron in an atom.

- And the effective nuclear charge (Z_{eff}) **is always less than** the nuclear charge (the total number of protons present in a nucleus).



The attraction and repulsion forces which affect the valence electrons

The graduation of atomic radius in the periodic table

In the horizontal period

"The atomic radius **decreases** as we go from **left to right** across the same period **by increasing** the atomic number from 1A to group zero"

The gradual **increase** in the effective nuclear charge (Z_{eff}) which **increases** the nuclear attraction to the valence electrons (pulling them closer to the nucleus) leading to **the decrease** in the atomic radius.

Because the increase in the atomic number results in

- **The increase** in the number of the energy levels in each new period.
- **The increase** in the number of the completely filled energy levels that screen more of the effective nuclear charge from the outer electrons.
- **Increasing** the repulsive forces between electrons.

Copper element ($_{29}\text{Cu}$)

The atomic radius increases as we go down the same group **by increasing** the atomic number from the first to the seventh period

General conclusion :

- The atoms of **the first group elements (alkali metals)** are the biggest atoms, while the atoms of **the seventh group elements (halogens)** are the smallest atoms.
- The biggest element atom in size is **cesium (Cs)**.

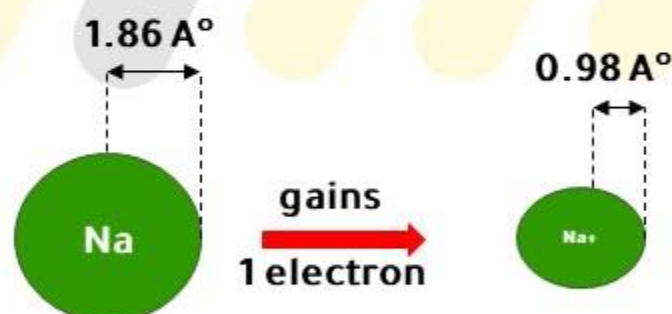
The relation between the radii of atoms and their ions

Metals

The positive ion (the cation) radius is **smaller than** the radius of its atom... G.R. ?

As the number of positive protons in the cation is higher than the number of negative electrons. So the attraction of the effective nuclear charge to remaining electrons increases leading to **decreasing the size**.

The sodium **metal** tends to **lose** its valence electron during chemical reactions to form sodium ion with a radius **smaller than** the radius of its atom.



Sodium atom $_{11}\text{Na}$
 $1s^2, 2s^2, 2p^6, 3s^1$
 11 protons
 11 electrons

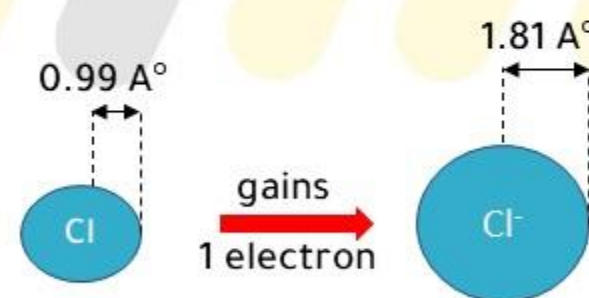
Sodium ion Na^+
 $1s^2, 2s^2, 2p^6$
 11 protons
 10 electrons

Nonmetals

The negative ion (the anion) radius is **larger than** the radius of its atom... G.R. ?

As the number of negative electrons in the anion is higher than the number of positive protons. So the repulsive forces between electrons increase due to increasing the number of electrons without any increase in the effective nuclear charge leading to **increasing the size**.

The chlorine **nonmetal** tends to **gain** an electron during chemical reactions to form chloride ion with a radius **larger than** the radius of its atom.



Chlorine atom $_{17}\text{Cl}$
 $1s^2, 2s^2, 2p^6, 3s^2, 3p^5$
 17 protons
 17 electrons

Chlorine ion Cl^-
 $1s^2, 2s^2, 2p^6, 3s^2, 3p^6$
 17 protons
 18 electrons

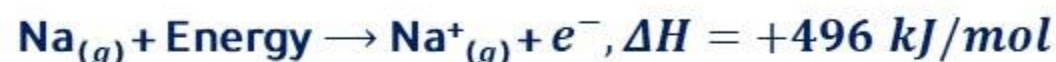
Application

2 (Ionization potential (Ionization energy)

If an amount of energy is supplied to an atom - when being in the gaseous state - electrons may be excited and transferred to higher energy levels, but if a sufficient amount of energy is supplied, the most loosely bound electron will be completely removed, giving a **positive ion**. The minimum amount of this energy is called **ionization potential**.

- ΔH of the ionization process has a **positive sign**.. G.R.?

Because the ionization energy is an absorbed energy.



Worked Example

The opposite table shows the first three ionization potentials E_1, E_2 and E_3 of a metal.

What is the charge of the most stable ion of this metal?

- (a) +1
- (b) +2
- (c) +3
- (d) +4

E_1	E_2	E_3
+590 kJ/mol	+1145 kJ/mol	+4912 kJ/mol

Idea of answering :

- ∴ The third ionization potential of this metal is much higher than its second ionization potential.
- ∴ It results in breaking a completely filled (a stable) energy level.
- ∴ The metal is divalent (belongs to group 2A).
- ∴ The charge of the most stable ion of this metal is +2

Answer: The correct choice is (b)

The graduation of ionization potential in the periodic table

In the same period

The first ionization potential **increases** as we move from **left** to **right**

In the same group

The first ionization energy **decreases** as we go **down** the group

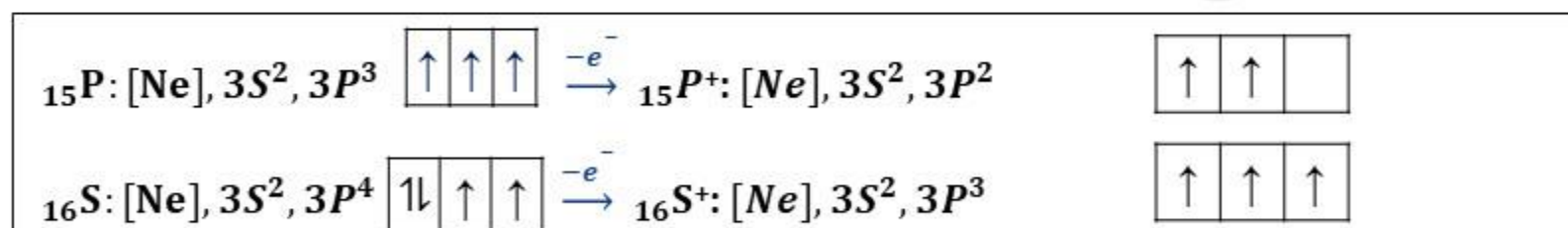
This is due to

The increase of the effective nuclear charge and **the decrease** of the atomic radius, which would lead to **increasing** the attraction of the nucleus to the valence electrons, so they need **higher energy** to be separated from the nucleus

- **The increase** in the number of energy levels which are completely filled with electrons which **increases** the atomic radius.
- **The decrease** of attraction of the nucleus to the valence electrons, so the energy required to remove the valence electrons **decreases**.
i.e the ionization potential is inversely proportional to the atomic radius

i.e the ionization potential is **inversely proportional** to the atomic radius

G.R. (1) The ionization potential of phosphorus $_{15}\text{P}$ is higher than the ionization potential of sulphur $_{16}\text{S}$, although phosphorus precedes sulphur in the same period.



Because the atom becomes more stable when the $3p$ sublevel is half filled with electrons as in phosphorus atom, and hence removing an electron from it will decrease its stability

(2) The ionization potential of aluminum $_{13}\text{Al}$ is lower than that of magnesium $_{12}\text{Mg}$, although aluminum comes after magnesium in the same period.



Because the atom becomes more stable when the $3s$ sublevel is **completely filled** with electrons as in magnesium atom, and hence removing an electron from it will decrease its stability.

3) Electron affinity

- electron affinity** which is the amount of energy released when an extra electron is added to a neutral gaseous atom.



- The magnitude of the electron affinity is high when the added electron makes the sublevel, half filled or completely filled, as in both cases it helps in the stability of the atom.

Test Yourself

Which of the following equations represents the electron affinity of chlorine?

- (a) $\text{Cl}_{(g)} \rightarrow \text{Cl}_{(g)}^{+} + e^{-}$
- (b) $\text{Cl}_{(g)} + e^{-} \rightarrow \text{Cl}_{(g)}^{-}$
- (c) $\text{Cl}_{2(g)} + e^{-} \rightarrow 2\text{Cl}_{(g)}^{-}$
- (d) $\text{Cl}_{(g)}^{+} + e^{-} \rightarrow \text{Cl}_{(g)}$

Answer: The correct choice is **b**.

The graduation of electron affinity in the periodic table

In the same period

The electron affinity **increases** as we move from **left** to **right**

The increase of the atomic number leads to **the decrease** in the atomic radius (and hence the atomic size), which **facilitates** for the nucleus to attract a new electron

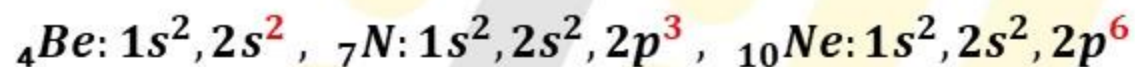
In the same group

The electron affinity **decreases** as we go **down** the group

The increase of the atomic number leads to **the increase** in the atomic radius (and hence the atomic size), which **hinders** the nucleus to attract a new electron

This is due to

G.R. (1) The electron affinity values for beryllium $_4\text{Be}$, nitrogen $_7\text{N}$ and neon $_{10}\text{Ne}$ are close to zero.



Because the atom will be more stable when the sublevel :

- $2s$ is completely filled as in case of beryllium atom $_4\text{Be}$
- $2p$ is half filled as in case of nitrogen atom $_7\text{N}$
- $2p$ is completely filled as in case of neon atom $_{10}\text{Ne}$ and the addition of an electron to any atom of them will decrease its stability.

(2) The electron affinity of chlorine (-349 kJ/mol) is greater than the electron affinity of fluorine (-328 kJ/mol), although chlorine follows fluorine in the same group.

Because fluorine atom is smaller in size as it has smaller radius than chlorine atom, so any new electron will suffer a strong repulsive force with the nine electrons already existing around the fluorine nucleus which decreases the released energy due to consuming a part of this energy to overcome this repulsive force.

4) Electronegativity

electronegativity which is the ability of an atom to attract the electrons of the chemical bond to itself.

The graduation of electronegativity in the periodic table

In the same period

The electronegativity **increases** as we move from **left to right**

The increase of the atomic number leading to **the decrease** of atomic radius, so the ability of the atom to attract the electrons of the bond **increases**

General conclusion :

- The atoms of nonmetals of group 7A (halogens) are the greatest in the electronegativity, while the atoms of the alkali metals of group 1A are the lowest in the electronegativity.
- Fluorine (F) is the most electronegative element, while cesium (Cs) is the lowest electronegative element.

In the same group

The electronegativity **decreases** as we go **down** the group

The increase of the atomic number leading to **the increase** of atomic radius, so the ability of the atom to attract the electrons of the bond **decreases**

This is due to

5) Metallic and nonmetallic property

A

Metals

- (1) Their valence shell - generally - has **less than** half its capacity of electrons.
- (2) They have **large** atomic radius which leads to **small** values for ionization energy and electron affinity.
- (3) They are **electropositive** elements,... G.R.
Due to their tendency to **lose** electrons of the valence shell and change into **positive** ions to reach the structure of the nearest noble gas.
- (4) They are **good** electric conductors,... G.R.
Due to the mobility of their few valence electrons, which can transfer from one position to another in the metal structure.

C

Metalloids

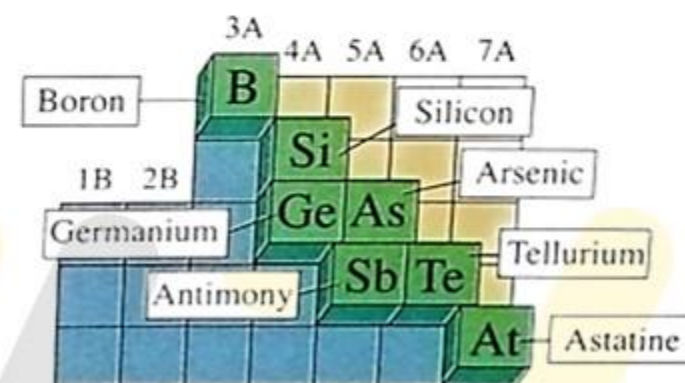
The metalloids are characterized by the following properties :

- (1) They have **the metallic** appearance and most of the properties of the nonmetals.
- (2) Their electronegativity is **intermediate** between metals and nonmetals.
- (3) Their electric conductivity is **less than** that of metals, but **more than** that of nonmetals.
- (4) They are used in manufacturing some electronic instruments parts, such as transistors, as they are **semiconductors**.

B

Nonmetals

- (1) Their valence shell - generally - has **more than** half its capacity of electrons.
- (2) They have **small** atomic radius which leads to **high** values for ionization energy and electron affinity.
- (3) They are **electronegative** elements,... G.R.
Due to their tendency to **gain** electrons to form **negative** ions that have the same electron structure of the nearest noble gas.
- (4) They don't conduct electricity (electric **insulators**),... G.R.
Because their valence electrons are strongly bound to the nucleus. Thus it is difficult for these valence electrons to be transferred.



The metalloids in the periodic table

The graduation of metallic and nonmetallic property in the periodic table

In the same period

The metallic property **increases** (the nonmetallic property **decreases**) with **the increase** in the atomic number as we go down the group... G.R. ?

Due to their large atomic radius and **the low** ionization potential and electron affinity

In the same group

The period begins with **the strongest metal** in group 1 A, then **the metallic property decreases gradually** by increasing the atomic number along the period till we reach **the metalloids**. To the right of the metalloids **the nonmetallic property** begins to appear.

The period ends with the elements of **the highest nonmetallic** property in group 7 A.

G.R. (1) Cesium Cs is considered the most active metal (loses its valence electron easily).

(2) Fluorine F is considered the most active nonmetal (gains a new electron easily).

Application : The graduation of metallic and nonmetallic property in the third period.

- The following figure expresses the graduation of metallic and nonmetallic property in the third period.
- It is clear that by increasing the atomic number, the metallic character **decreases** and the nonmetallic character **increases**.

Third period

	11Na Sodium	12Mg Magnesium	13Al Aluminum	14Si Silicon	15P Phosphorus	16S Sulphur	17Cl Chlorine
Electron configuration	3s ¹	3s ²	3s ² , 3p ¹	3s ² , 3p ²	3s ² , 3p ³	3s ² , 3p ⁴	3s ² , 3p ⁵
Element type	Strong metal	Metal	Metal	Metalloid	Nonmetal	Nonmetal	Strong nonmetal

As the atomic number increases, the metallic property **decreases** and the nonmetallic property **increases**

Test Yourself

(1) Which of the following represents the electronic configuration of the most electropositive element?

- (a) [He], 2s¹ (b) [Ne], 3s² (c) [Xe], 6s¹ (d) [Xe], 6s²

Answer: The correct choice is **c**

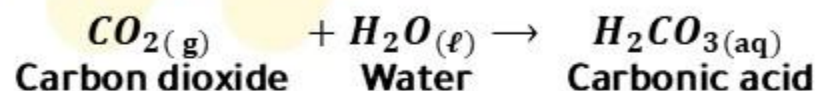
6) Acidic and basic property

A) Acidic oxides

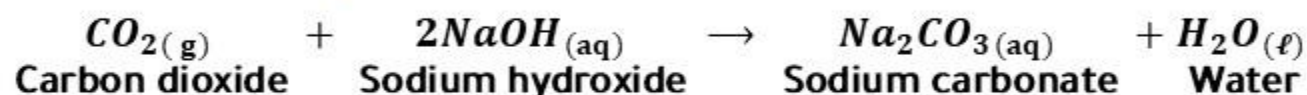
- The **nonmetals** oxides are usually known as acidic oxides, .. G.R.?

Because :

- (1) They dissolve in water forming oxygenated **acids**.



- (2) They react with **alkalis** forming salt and water.

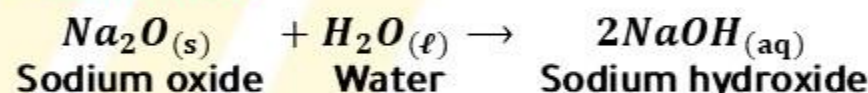


Among the acidic oxides

- Carbon dioxide CO_2
- Sulphur trioxide SO_3
- Nitrogen dioxide NO_2

B) Basic oxides

- The **metals** oxides are usually known as **basic** oxides.
- Some basic oxides are not soluble in water and others are soluble in water forming **alkalis**, the water soluble basic oxides are also known as **alkali oxides**



Among the basic oxides

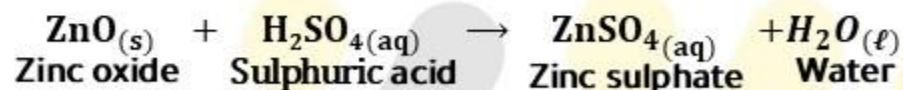
- Sodium oxide Na_2O
- Potassium oxide K_2O
- Magnesium oxide MgO

They react with **acids** forming salt and water:



C) Amphoteric oxides

Amphoteric oxides are elements oxides that react with acids as basic oxides and react with alkalis as acidic oxides forming in both cases salt and water.



Among the amphoteric oxides

- Aluminum oxide Al_2O_3
- Zinc oxide ZnO
- Antimony oxide Sb_2O_3
- Tin (II) oxide SnO

Application:

The graduation of acidic and basic property in the third period.

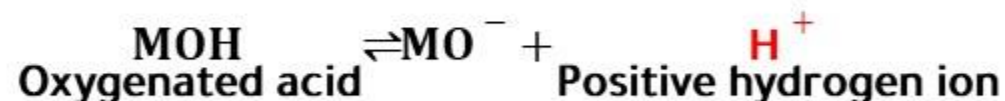
- The following figure expresses the graduation of acidic and basic property in the third period. **It is shown that**, as the atomic number increases the basic property decreases and the acidic property increases.

Third period	¹¹ Na Sodium	¹² Mg Magnesium	¹³ Al Aluminium	¹⁴ Si Silicon	¹⁵ P Phosphorus	¹⁶ S Sulphur	¹⁷ Cl Chlorine
Element oxide	Na ₂ O	MgO	Al ₂ O ₃	SiO ₂	P ₂ O ₅	SO ₃	Cl ₂ O ₇
Oxide type	Basic oxide		Amphoteric oxide	Acidic oxide			
The graduation of the acidic and basic property	NaOH	Mg(OH) ₂	Al(OH) ₃	H ₄ SiO ₄	H ₃ PO ₄	H ₂ SO ₄	HClO ₄
	Strong base	Weak base	Amphoteric substance	Weak acid	Moderate acid	Strong acid	The strongest acid

As the atomic number increases, the basic property **decreases** and the acidic property **increases**

The compound will be ionized as **an acid** if :

The (M–O) bond is **stronger than** the (O–H) bond.
(**i.e.** The attraction between M⁺ and O[–] is **stronger than** that between H⁺ and O[–]).



The compound will be ionized as **a base** if :

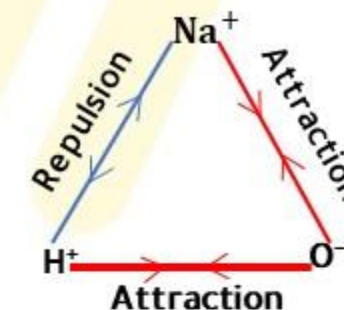
The (O–H) bond is **stronger than** the (M–O) bond.
(**i.e.** The attraction between H⁺ and O[–] is **stronger than** that between M⁺ and O[–]).



Application: (1) The basic property of sodium hydroxide.

- Sodium hydroxide is ionized as a **base**, where sodium atom has a **large volume** and its ion has only one positive charge. Accordingly, the attraction between Na^+ and O^{--} decreases

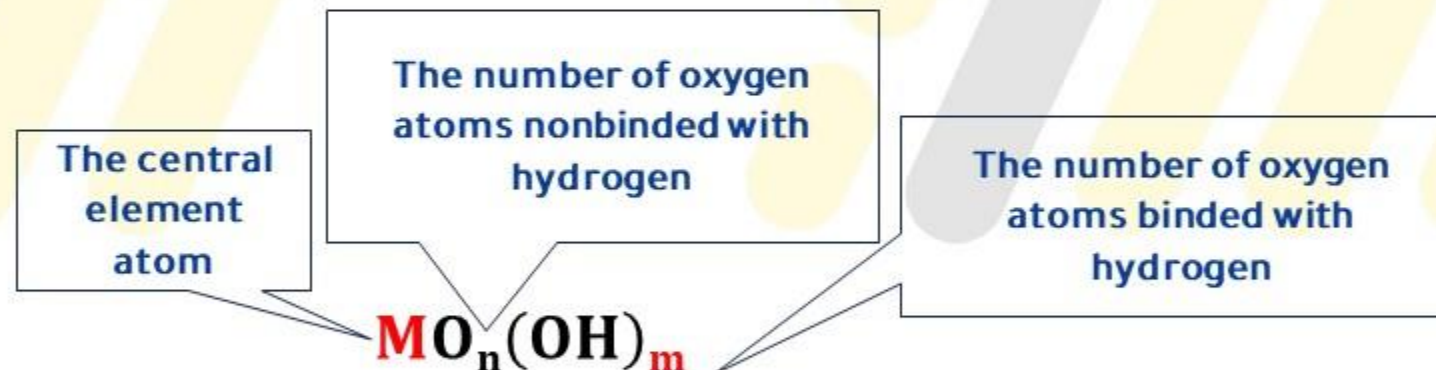
i.e. The (O – H) bond is stronger than that of the (Na – O) bond. So OH^- ion is produced.



Attraction forces in NaOH compound

The strength of the oxygenated acids (oxyacid's)

- The oxygenated acids are represented by the following general formula :



- The strength of the oxygenated acid (oxyacid) increases as the number of nonbinded oxygen atoms (O_n) with hydrogen increases.

Worked Example

Among the oxygenated acids are :

HBrO

HBrO₂

HBrO₃

Which of the following is correct for these acids ?

- (a) HBrO is the weakest acid among these three acids.
- (b) HBrO₃ acid contains 3 oxygen atoms nonbonded to hydrogen atoms.
- (c) HBrO₂ is the strongest acid among these three acids.
- (d) The ratio (n:m) in HBrO equals (1:1).

Idea of answering :

The following table exhibits the hydroxy formulas of these oxygenated acids, and (n:m) ratio in each of them :

Oxygenated acid	HBrO	HBrO ₂	HBrO ₃
Hydroxy formula	Br(OH)	BrO(OH)	BrO ₂ (OH)
n: m	0: 1	1: 1	2: 1

∴ The strength of the oxygenated acid increases by increasing the number of nonbonded oxygen atoms with hydrogen.

∴ These acids are ordered ascendingly according to the strength as follows :



Answer: The correct choice is (a)

7) Oxidation numbers (states)

Oxidation number is a number that refers to the electric charge (positive or negative) that the atom or ion would carry in the compound, whether it is an ionic or a covalent compound.

In ionic compounds

In covalent compounds

Positive oxidation number indicates

The number of electrons that the atom has
lost to give a positive ion (cation)

The shift of the bond electrons away from
the less electronegative atom

Negative oxidation number indicates

The number of electrons that the atom has **gained** to give a **negative ion (anion)**

The shift of the bond electrons towards **the more electronegative atom**

Worked Examples

(1) Calculate the oxidation number of :

- (1) Chlorine in: (i) Cl_2 (ii) $KClO_4$
 (2) Sulphur in: (i) $(SO_4)^{2-}$ (ii) $Na_2S_2O_3$
 (3) Chromium in: $Cr_2(SO_4)_3$
 (4) Nitrogen in : $(NH_4)^+(NO_2)^-$

Answer:

(1) (i) $2Cl = 0 \therefore Cl = 0$

(ii) $KClO_4$, $+1 + Cl + (-2 \times 4) = 0$, $Cl - 7 = 0 \therefore Cl = +7$

(2) (i) $(SO_4)^{2-}$, $S + (-2 \times 4) = -2$, $S = -2 + 8 \therefore S = +6$

(ii) $Na_2S_2O_3$, $(+1 \times 2) + 2S + (-2 \times 3) = 0$, $2S = +4 \therefore S = +2$

(3) $Cr_2(SO_4)_3$, $2Cr + (-2 \times 3) = 0$, $2Cr = +6 \therefore Cr = +3$

(4) $(NH_4)^+(NO_2)^-$ is an ionic compound which consists of two atomic groups, the oxidation number of nitrogen in each of them is different.

$(NH_4)^+$, $N + (+1 \times 4) = +1$, $N = 1 - 4 \therefore N = -3$

$(NO_2)^-$, $N + (-2 \times 2) = -1$, $N = -1 + 4 \therefore N = +3$

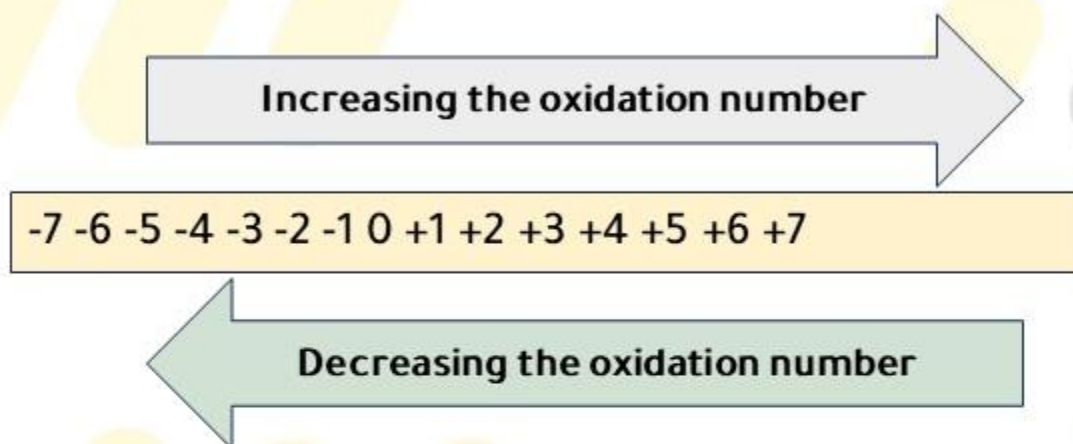
Disproportionation reactions :

Chemical reactions in which both the oxidation and the reduction processes occur to the same element atom or ion in the same reactant.

Calculating the change of the oxidation number in an oxidation-reduction reaction (redox reaction)

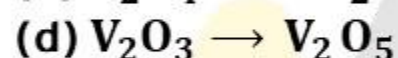
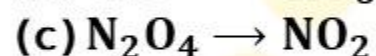
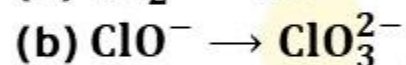
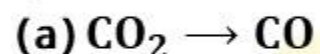
Oxidation

It is the process of **losing** electrons resulting in **increasing** the positive charge or **decreasing** the negative charge

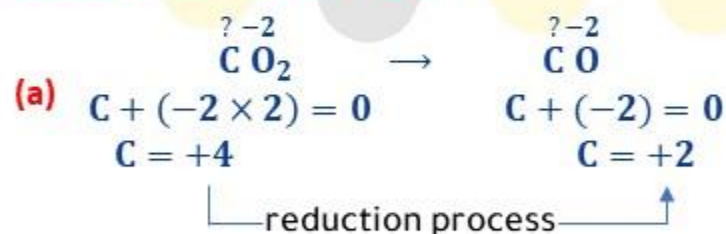


Worked Examples

1) Each of the following changes represents either an oxidation or a reduction reaction, except.....



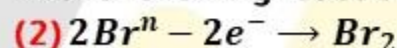
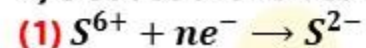
Idea of answering :



∴ Carbon underwent a **reduction** process, as its oxidation no. decreased from +4 to +2

∴ The choice (a) is excluded.

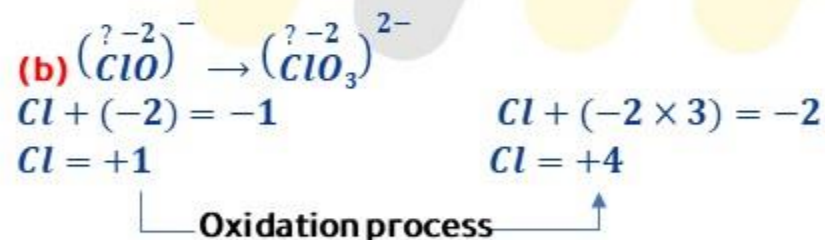
2) Deduce the values of 'n' in the following reactions:



Answer:

(1) $6 + (n \times -1) = -2, 6 - n = -2 \quad \therefore n = +8$

(2) $2n - (2 \times -1) = 0, 2n + 2 = 0, 2n = -2 \quad \therefore n = -1$



∴ Chlorine underwent an **oxidation** process, as its oxidation no. increased from +1 to +4

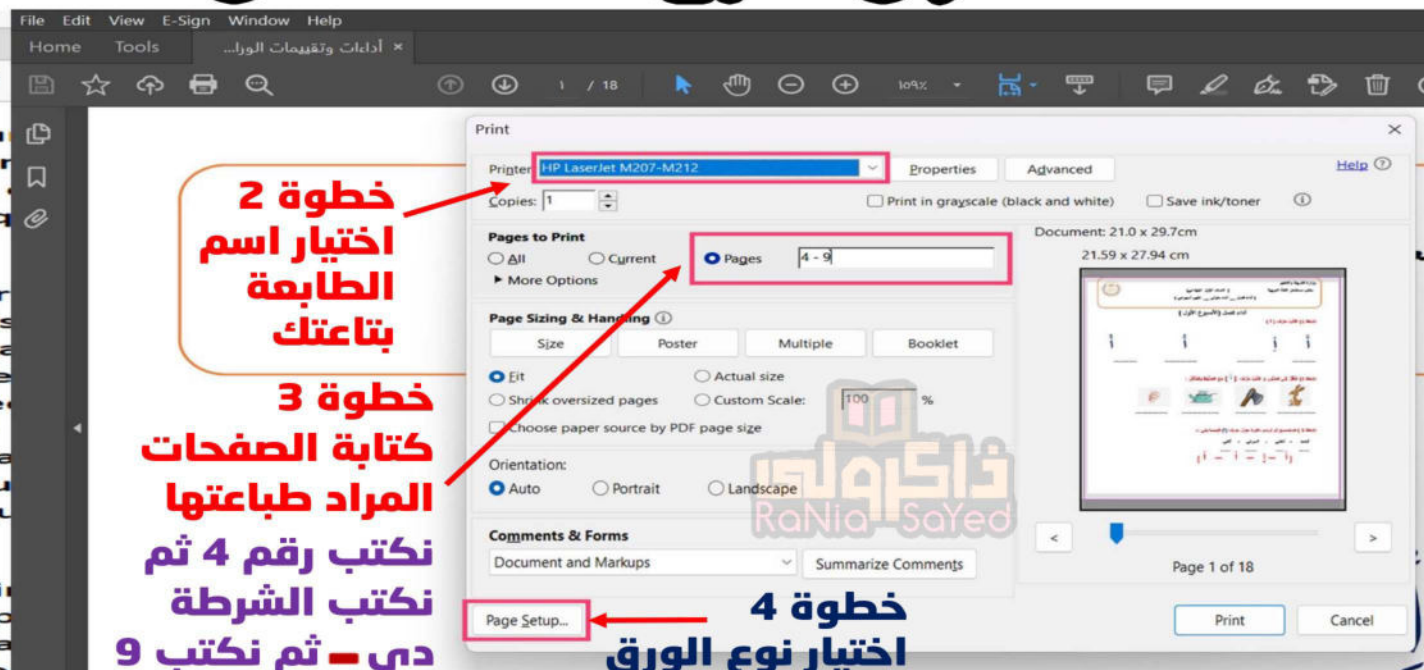
∴ The choice (b) is excluded.

كيفية طباعة صفحات معينة من ملف معين

مثلا ازاي نطبع الصفحات من صفحة 4 الى صفحة 9



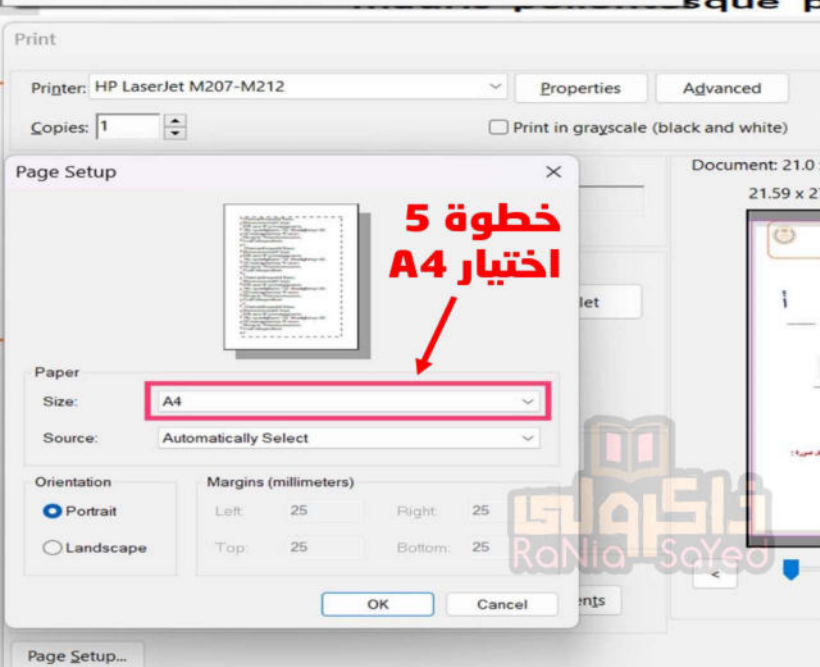
خطوة 1



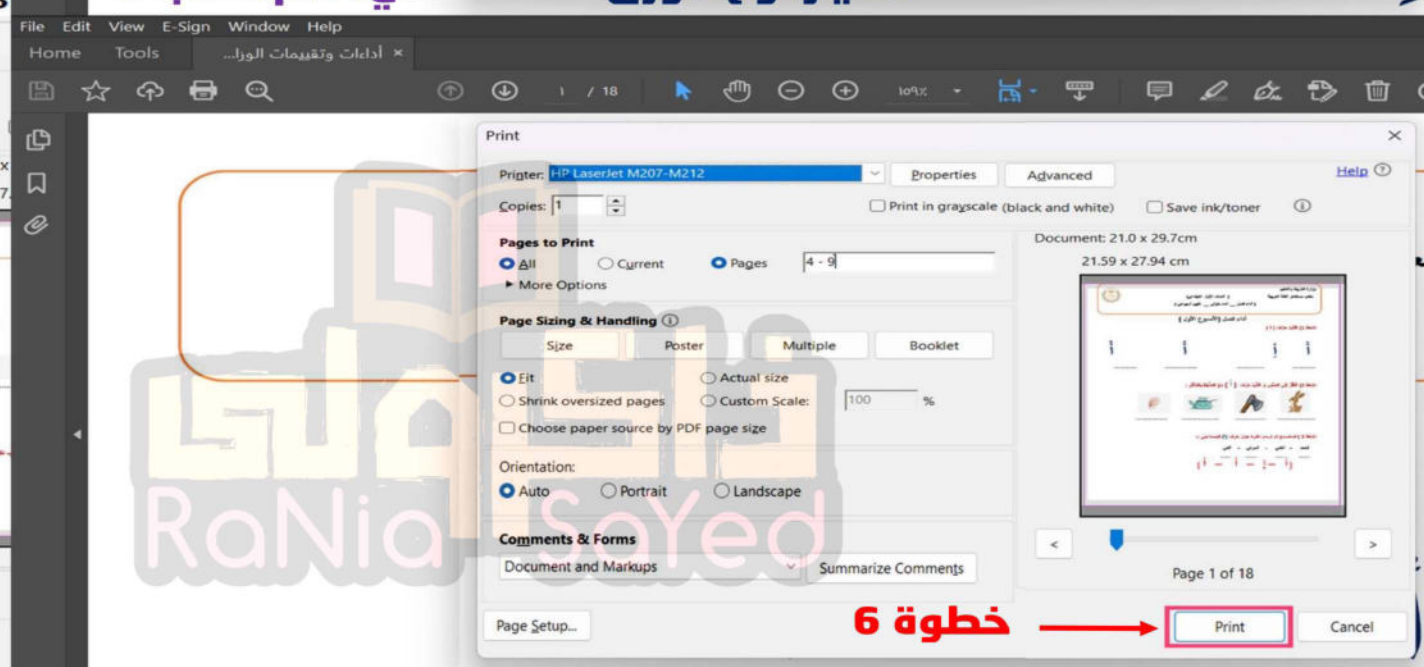
خطوة 2
اختيار اسم
الطابعة
بتاعتك

خطوة 3
كتابة الصفحات
المراد طباعتها
نكتب رقم 4 ثم
نكتب الشرطة
دي - ثم نكتب 9

خطوة 4
اختيار نوع الورق



خطوة 5
اختيار A4



خطوة 6

حمل الآن

مجاناً وحصرياً

المراجعة رقم (2)

الترم الاول



الإدارة المركزية للتعليم العام
مكتب تنمية مادة العلوم

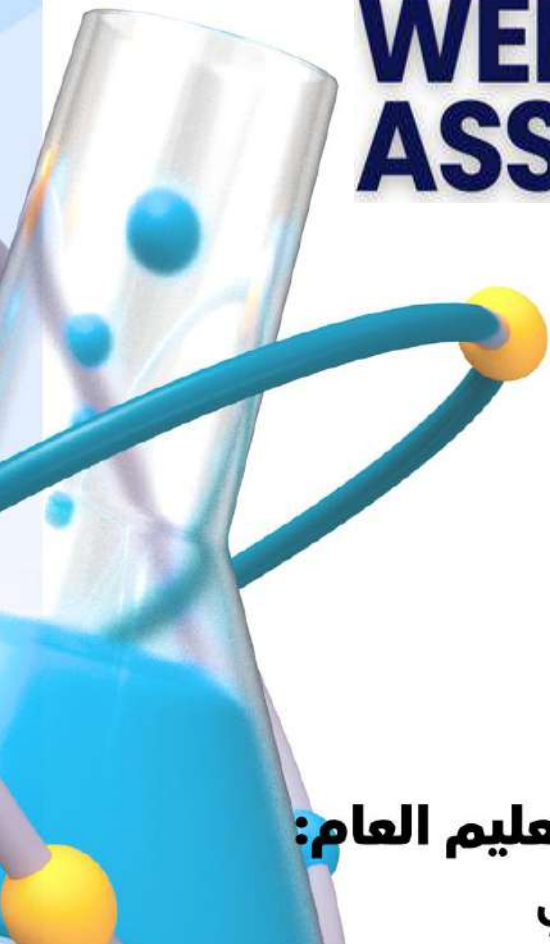


CHEMISTRY

2nd secondary
first term

HOME PERFORMANCE

WEEKLY ASSESSMENTS



إعداد:

أ. سامح منصور

أ. عبدالله عبدالواحد

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د. عزيزة رجب خليفة

رئيس الإدارة المركزية للتعليم العام:

د. هالة عبدالسلام خفاجي

2026

week



Home Performance- Week 1

Q1/ choose the correct answer: -

1-What is the mass of 2.52×10^{-3} mol of ammonium sulphate?

[H=1, N=14, O=16, S=32]

- (a) 0.287 g
- (b) 0.285 g
- (C) 0.328 g
- (d) 0.333 g

2- Which of the following has the same number of molecules as 11.2 L of methane (CH_4) gas at STP?

[H=1, N=14, C=12]

- (a) 1 mole of nitrogen gas at STP
- (b) 3.01×10^{23} molecules of hydrogen gas
- (C) 4 g of methane gas
- (d) 17 gm of ammonia (NH_3) gas at STP

3-The number of sulphate ions in 17.1 gm of aluminum sulphate =.....

[Al=27, S=32, O=16]

- (a) 3×10^{21}
- (b) 1×10^{22}
- (C) 3×10^{22}
- (d) 9×10^{22}

4- The number of atoms in 0.25 mole of formaldehyde (HCHO)

=.....

- (a) Avogadro's number
- (b) Half Avogadro's number
- (C) Quarter Avogadro's number
- (d) Four times Avogadro's number

5- Which of the following represents the volume of 32 g of sulphur dioxide gas at STP?

[S=32, O=16]

- (a) 22.4 L
- (b) 11.2 L
- (C) 5.6 L
- (d) 44.8 L



6- The number of moles of atoms in half mole of nitrogen tetra oxide (N_2O_4) is mole

- (a) 3.01×10^{23}
- (b) 3
- (C) 6.02×10^{23}
- (d) 6

7- What is the molar mass of a gas if 1.5 L of the gas at STP has a mass of 3.0 g?

- (a) 22.4 g/mol
- (b) 44.8 g/mol
- (C) 11.2 g/mol
- (d) 2.0 g/mol

8-Which of the following is true for 1.0 mole of water (H_2O) and 32 of Oxygen gas (O_2)?

- (a) They have the same volume.
- (b) They have the same mass.
- (C) They contain the same number of molecules.
- (d) They contain the same number of atoms.

9- If you have 1.5 moles of a solid compound, which of the following can you determine from this information alone?

- (a) Its density.
- (b) Its volume at STP.
- (C) Its molar mass.
- (d) The number of particles (atoms or molecules) in the sample.

10-A balloon contains 2.0×10^{23} molecules of a gas at STP. If the mass of the gas is 9.296 g, what is this of the gas? [$\text{N}=14$, $\text{O}=16$, $\text{C}=12$, $\text{H}=1$]

- (a) Oxygen gas
- (b) Nitrogen gas
- (C) Methane gas
- (d) Ammonia gas



Weekly Assessment- Week 1

Q1/ Give scientific reason for each of the following:

1- The number of oxygen atoms in 32 g of oxygen gas is twice the number of Hydrogen molecules in 2 g of hydrogen gas.

[H=1, O=16]

2- The number of anions is half the number of cations in each mole of sodium Sulphate.

3- The volume of 4 g of hydrogen gas is equal to the volume of 32 g of oxygen Atoms

4- The molar mass varies from one substance to another.

5- The molar volume of sodium chloride is not equal to 22.4 L at STP.

6- The molar volume of hydrogen and oxygen gases under the same

Conditions of pressure and temperature is equal, despite the difference in Their molar masses.

7- Equal volumes of oxygen and ozone gases contain different numbers of Oxygen atoms.

.....

.....

.....

.....

Q2 / If you know that phosphorus in its vapour state is tetratomic, calculate The number of phosphorus atoms in 30 g of phosphorus in its vapour State.

[P = 30]

.....

.....

.....



Q3 / which of balloons (1) and (2) contains oxygen gas and which contains Hydrogen gas, given that the weight of the gas in each is 3.2 g? Why?

[O = 16, H=1]

Balloon (1)

Balloon (2)



Q4 / Calculate the mass of each of the following:

- 1- 1.505×10^{23} units of silver phosphate. [Ag= 108 , P =30, O=16]
- 2- 11.2 L of sulphur dioxide gas SO_2 [S= 32 , O=16]
- 3- 0.5 moles of sulphur in its vapour state, knowing that each molecule of Sulphur in its vapour state consists of 8 atoms. [S= 32]
- 4- Moles of hydrated sodium sulphate, knowing that each mole of hydrated Sodium sulphate consists of one mole of sodium sulphate binds with Seven moles of water. [Na= 23, S =32, O=16, H=1]

Q5 / Calculate the mass of an oxygen atom in grams. [O=16 amu]

Q6 / Calculate the number of moles of atoms in 0.5 moles of acetic acid (CH_3COOH).



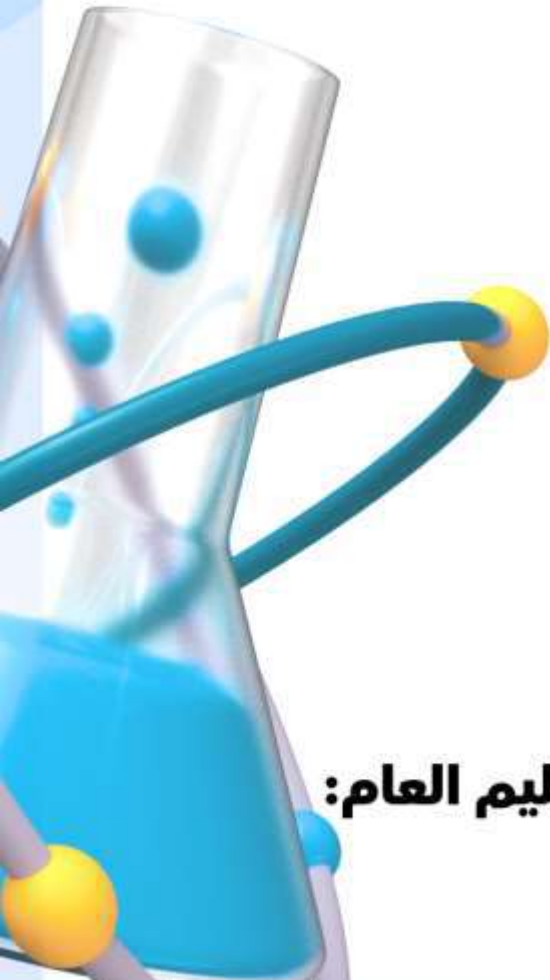
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CHEMISTRY

2nd secondary
first term

HOME PERFORMANCE



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2026

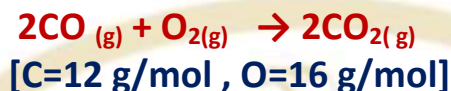
week

2

Home performance (Week 2)

Q1/ choose the correct answer:-

1- At STP, calculate the volume of CO_2 gas produced by mixing 20 g of CO gas with an excess amount of oxygen gas according to the following equation:



- (a) 45 L
- (b) 8 L
- (c) 23 L
- (d) 16 L

2-At 25°C and 1atm, a gas occupies a volume of 4L , How many moles are there?

- (a) 0.18 moles of gas molecules
- (b) 0.93 moles of gas molecules
- (c) 0.17 moles of gas molecules
- (d) 8.96 moles of gas molecules

3-How many grams of oxygen gas are necessary to react completely with 2.93×10^{21} atoms of magnesium to yield magnesium oxide?



- (a) 2.68×10^{-2} g
- (b) 6.18×10^{-4} g
- (c) 1.56×10^{-1} g
- (d) 7.78×10^{-2} g

4- Propane (C_3H_8) burns completely in excess amount of oxygen (O_2) according to the following equation:



-If 11.0 grams of C_3H_8 is completely combusted at room temperature , then the volume of CO_2 gas produced is

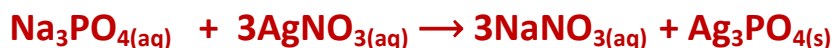


- (a) 30 cm^3
- (b) 30 L
- (c) 18 L
- (d) 55L



5- Phosphate radical is detected in its sodium salt by silver nitrate solution

According to the following equation:

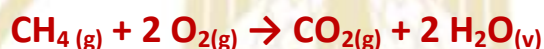


-if you start with a pure sample of the sodium Phosphate salt weighs 5 grams, calculate the mass of formed precipitate?

[Na_3PO_4 =164 g/mol, AgNO_3 =170g/mol, NaNO_3 =85g/mol, Ag_3PO_4 =419g/mol]

- (a) 12.77 g
- (b) 12.32 g
- (C) 1.95g
- (d) 5.00 g

6- Methane gas reacts with oxygen according to the following equation:

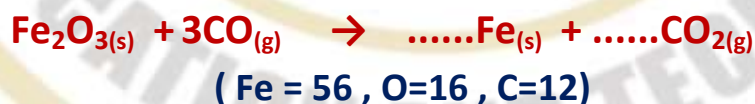


- If 60 g of oxygen gas is added to 20 gm of methane gas in a closed container ,
Calculate the total mass of gases and vapors at the end of reaction?

(C=12 g/mol, H=1 g/mol , O =16 g/mol)

- (a) 100 g
- (b) 46.25 g
- (C) 5 g
- (d) 80 g

7- Balance the chemical equation for reduction of iron III oxide by carbon monoxide , then calculate the volume of carbon dioxide gas evolved at 273°K and 1 atm from the reaction of 1.6 gm of iron III oxide with 1.68 g of carbon monoxide.

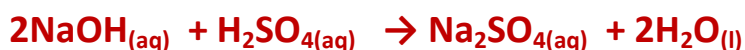


- (a) 0.672
- (b) 1.344
- (C) 0.224
- (d) 67.2



8-In the neutralization reaction between sodium hydroxide and sulphuric acid

According to the equation: -



-If 80 gm of sodium hydroxide is added to 49 gm of sulfuric acid, then which of The following exists in water at the end of reaction?

- (a) Sodium hydroxide and sodium sulphate
- (b) Sulphuric acid and sodium sulphate
- (C) Sodium hydroxide and sulphuric acid
- (d) Sodium hydroxide , sodium sulphate and sulphuric acid

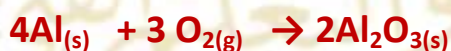
9- Ammonia gas (NH_3) is produced by the reaction of nitrogen (N_2) and Hydrogen (H_2):

-How many grams of nitrogen gas are required to prepare 72 liters of ammonia at STP?

(N=14 g/mol, H=1 g/mol)

- (a) 35.99 g
- (b) 33.60 g
- (C) 42.00g
- (d) 44.99 g

10- How many grams of Aluminum metal will be completely oxidized by 44.8L of oxygen at STP according to the following equation?



[Al=27, O = 16]

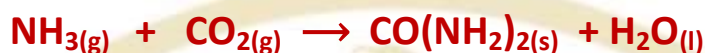
- (a) 54 gm
- (b) 108 gm
- (C) 27 gm
- (d) 72 gm



Weekly assessment (Week-2)

Question (1):-

Urea is an important fertilizer, prepared in industry from the reaction of ammonia (NH_3) gas and carbon dioxide gas (CO_2) according to the unbalanced equation below:



- In a large batch reaction, 6.0×10^4 grams of ammonia (NH_3) are mixed with 1.1×10^5 grams of carbon dioxide (CO_2).

1. Balance the chemical equation.

2. Determine the limiting reactant for this reaction.

3. Calculate the yield (in kilograms) of urea [$\text{CO}(\text{NH}_2)_2$] that can be produced.

4. Calculate the mass (in kilograms) of the excess reactant remaining after the reaction is complete.

(Atomic Masses: N=14.0 g/mol, C=12.0 g/mol, O=16.0 g/mol, H=1.0 g/mol)

Question (2):-

A student conducts an experiment to synthesize iron (III) oxide (Fe_2O_3) by reacting iron metal (Fe) with oxygen gas (O_2) at high temperature.

According to the balanced equation: $4\text{Fe}_{(s)} + 3\text{O}_{2(g)} \rightarrow 2\text{Fe}_2\text{O}_{3(s)}$

- The student starts with 11.17 grams of solid iron (Fe) and allows it to react with 4.48 liters of oxygen gas (O_2) measured at 25°C and 1 atm.

[Fe=55.85 g/mol, O=16.00 g/mol]

1-Determine the limiting reactant for this reaction.

2-Calculate the expected yield (in grams) of Fe_2O_3

3-Calculate the mass in grams of the limiting reactant that is needed to Completely react with the remaining amount of the other reactant.



Question (3):-

Given that 7.3 grams of hydrochloric acid is necessary for the complete reaction with a sample of 12.5 gram calcium carbonate, according to the following unbalanced equation:



1-Determine whether the sample is pure or impure.

2-Calculate the volume of evolved carbon dioxide gas at 298°K and 760 mmHg

3-Calculate the mass of impurities in the sample if it found.

Question (4):-

-In front of you four balloons contain different gases under the same conditions of temperature and pressure, study the figure well then answer.



(1)

(2)

(3)

(4)

1-Determine balloons those contains the same number of gas molecules.

2- Given that volume of balloon (2) double that of the balloon (3) , determine the ratio between number of molecules and number of atoms in the two balloons respectively, explain your answer?



3- Given that volume of balloon (1) is 4.48 L at 25° C and 760 mmHg calculate how many liters of gas in balloon (2) is required to completely react with the gas in balloon (1)?

.....

Question (5):-

- Ammonia gas (NH₃) is produced by the reaction of nitrogen (N₂) and Hydrogen (H₂):

-How many grams of nitrogen gas are required to prepare 72 liters of ammonia at STP? (N=14 g/mol, H=1 g/mol)

.....

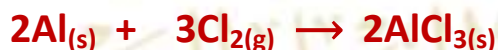
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Question (6):-

- Consider the reaction between aluminum metal (Al) and chlorine gas (Cl₂) to produce aluminum chloride (AlCl₃).according to the following equation :



-A chemist mixes 20 grams of aluminum (Al) with 30 grams of chlorine gas (Cl₂) in a reaction vessel.

1-Identify the Limiting Reactant.

.....

.....

2-Calculate the mass of the yield (in grams).

.....

.....

3-Calculate the mass (in grams) of the excess reactant that remains after The reaction is complete.

(Al=27 g/mol, Cl=35.5 g/mol)

.....

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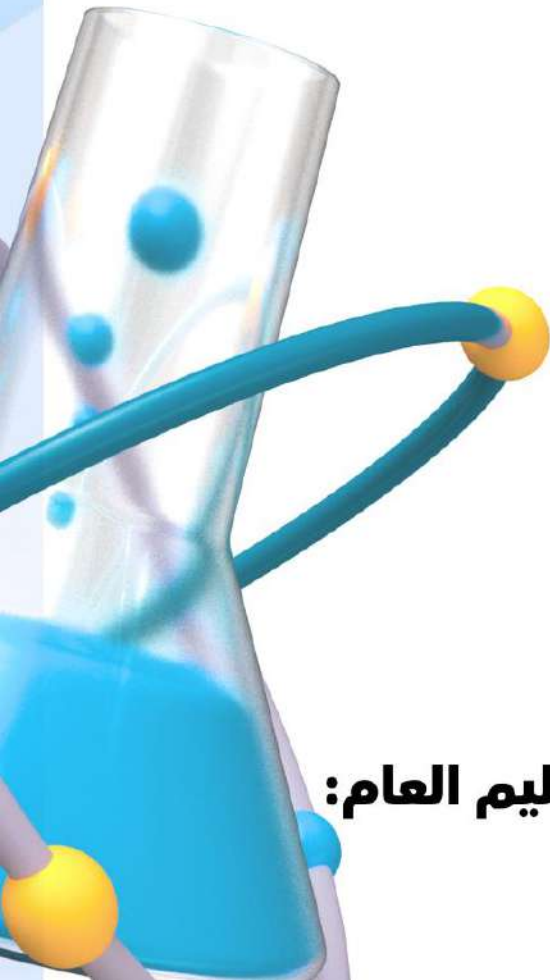
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2026

week

3

Home performance (Week 3)

Q1/ choose the correct answer:-

1 The empirical formula of the compound resulting from the combination of two elements (X, Z) and their respective masses (4g, 1.4g) is

[X=16 , Z= 14]

- (a) ZX_2
- (b) ZX
- (c) Z_2X_3
- (d) Z_2X_5

2-Two different compounds are ethanol (ethyl alcohol) and dimethyl ether, which have the same molecular formula C_2H_6O . However, they differ in their properties. Which formula should be used to distinguish between them?

- (a) The empirical formula
- (b) The molecular formula
- (c) The structural formula
- (d) The positive formula

3- If the molar mass of a compound is 78 g/mol and its empirical formula is CH , what is the molecular formula of the compound? [C=12 , H=1]

- (a) C_2H_2
- (b) C_4H_4
- (c) C_6H_6
- (d) C_8H_8

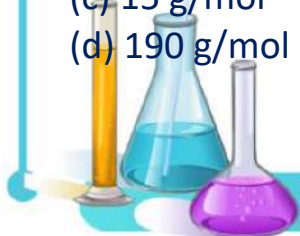
4. Which of the following is true for a hydrocarbon compound containing 85.6% carbon and 14.4% hydrogen?

- (a) It has the empirical formula CH , molecular formula C_2H_2
- (b) It has the empirical formula CH_2 , molecular formula C_3H_8
- (c) It has the empirical formula CH_4 and the molecular formula C_2H_8
- (d) It has the empirical formula CH_2 and the molecular formula C_4H_8

5. If you know that the empirical formula of a carbohydrate is CH_2O , which of the following could represent the molar mass of the compound?

[O=16, H=1, C=12]

- (a) 30 g/mol
- (b) 180 g/mol
- (c) 15 g/mol
- (d) 190 g/mol



6- A hydrocarbon compound has a mass percentage of carbon of 85.747%. Its molecular formula is [The molar mass of the compound is 56g/mol]

(H=1, C=12)

- (a) C_2H_2
- (b) C_4H_4
- (c) C_6H_6
- (d) C_8H_8

7- 7 gm of metal (X) reacts completely with 4.67 gm of nitrogen gas to form a compound with the chemical formula.

[X=7 , N=14]

- (a) X_2N
- (b) X_3N
- (c) X_2N_3
- (d) XN_3

8- Chemical analysis has shown that acetic acid (vinegar) consists of 40% carbon, 6.67% hydrogen, and 53.33% oxygen by mass. If its molar mass is 60 gm, the molecular formula of the acid is ...

(O=16, H=1, C=12)

- (a) CH_2O
- (b) C_2H_4O
- (c) $C_2H_4O_2$
- (d) CH_4O_2

9- When 0.3 mol of element (X) combines with 0.2 mol of element (Y), a compound with the molecular formula is formed.

- (a) X_2Y
- (b) X_3Y
- (c) X_2Y_3
- (d) X_3Y_2

10- The number of empirical formula units in glucose $C_6H_{12}O_6$ =.....

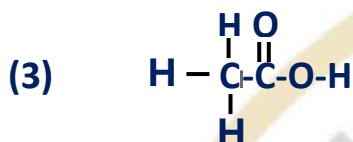
- (a) 6
- (b) 4
- (c) 3
- (d) 2



Weekly assessment (Week-3)

Question (1):-

1- Classify the following chemical formulas for acetic acid as structural, molecular, and empirical.



2- If you know that upon complete combustion of half a mole of hydrocarbon, 24 L of carbon dioxide gas is produced at (rtp) and 18 g of water vapor.

- Calculate the empirical formula of the hydrocarbon.

3- Calculate the empirical formula of one of nitrogen oxides, knowing that a mass of 15.369 g of it contains 4.68 g of nitrogen.

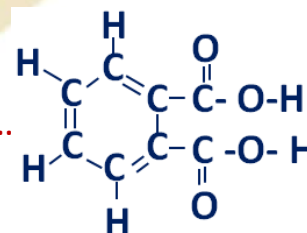
Question (2):-

1- An ionic compound contains 29.08% sodium, 40.56% sulfur, and 30.36% oxygen by mass. What is the formula of the sulfur-containing anion in the compound, and determine the number of electric charges carried by the anion.

2- Phthalic acid is an organic acid used in many industries, such as plastic production, dye manufacturing, and perfumery. The figure below shows the chemical formula for this acid.

(a) Identify the type of chemical formula shown in the figure.

(b) Write the other possible chemical formulas for the acid
Based on what you have studied.



3- What is the empirical formula and molecular formula of a hydrocarbon Compound with a carbon mass three times that of hydrogen?



Question (3):-

1- Calculate the empirical formula of iron oxide containing 77.78% iron by mass.
(Fe=56, O=16)

2- An organic compound contains 24.24% carbon, 4.40% hydrogen, and 71.78% chlorine.

- Calculate the molecular formula of the compound, knowing that its molar mass = 99 gm/mol.

(C=12, Cl=35.5, H=1)

3- What is the molecular formula of hydrazine, given that its empirical formula is NH_2 and its molar mass is 32 g/mol (N=14, H=1)?

Question (4):- Choose the correct answer:-

1- If you know that the formula C_4H_{10} can represent two different compounds (butane and isobutane), what type of chemical formula can distinguish between these two compounds?

- (a) Empirical formula
- (b) Molecular formula
- (c) Structural formula
- (d) The ionic formula

2- Which of the following compounds has molecular formulas that match its empirical formula?

- (a) Benzene C_6H_6
- (b) Formaldehyde HCHO
- (c) Acetylene C_2H_2
- (d) Oxalic acid $\text{C}_2\text{H}_2\text{O}_4$

3- Chemical analysis has shown that a chemical compound consists of 40% element (A) and 12% element (B) by mass. The molecular formula of the compound is

[A = 40 , B=12, C = 16]

- (a) ABC_3
- (b) A_3BC
- (c) AB_3C
- (d) $\text{A}_2\text{B}_2\text{C}$



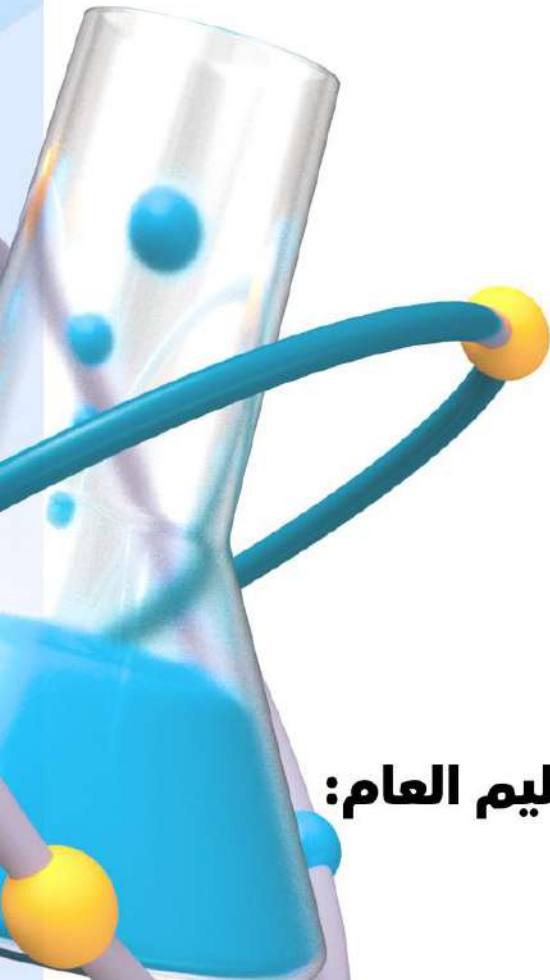
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2026

week

4

Home performance (Week 4)

Q1/ choose the correct answer:-

1-100 ml of 0.5 M magnesium hydroxide is mixed with 200 ml of 0.6 M hydrochloric acid according the following equation:-



- The concentration of the excess anion after the reaction =.....

- (a) 0.2 M
- (b) 0.475 M
- (c) 0.0633 M
- (d) 0.316 M

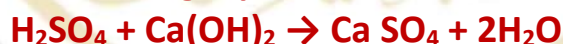
2-The volume of 2M sulphuric acid required to prepare 250 mL of 0.25 M solution=...

- (a) 32 mL
- (b) 31.250 L
- (c) 0.0312 mL
- (d) 31.250 mL

3- How many grams of sodium phosphate required preparing 2L of 0.3 M solution?
(Na=23 , P=31 , O=16)

- (a) 98.4 g
- (b) 9.84 g
- (c) 4.85 g
- (d) 49.2 g

4- On adding 200 mL of 0.2 M sulphuric acid to 300 mL of 0.2 M of calcium hydroxide according the following equation:-



- the molarity of unreacted substance=.....

- (a) 0.080 M
- (b) 0.040 M
- (c) 0.066 M
- (d) 0.100M

5- In a molar solution of sodium chloride every 100 mL of the solutions containsgrams of the salt

- (a) 58.5
- (b) 5.85
- (c) 0.10
- (d) 0.01



6- If the molar concentration of aluminum ions, Al^{3+} , in a solution of aluminum sulfate, $\text{Al}_2(\text{SO}_4)_3$, is 0.60 M, what is the molarity of the salt solution?

- (a) 0.90 M
- (b) 1.20 M
- (c) 0.60 M
- (d) 0.30 M

7- What is the mass of calcium chloride needed to prepare 2.0 L of a solution that has a chloride ion (Cl^-) concentration of 0.50 M? ($\text{CaCl}_2 = 111 \text{ g/mol}$)

- (a) 27.75 g
- (b) 13.9 g
- (c) 55.5 g
- (d) 111.0 g

8- 100 mL sample of 0.50 M lithium sulfate (Li_2SO_4) is diluted to a final volume of 400 mL. What is the final molar concentration of lithium ions, Li^+ ?

- (a) 0.125 M
- (b) 0.50 M
- (c) 0.25 M
- (d) 0.0625 M

9- Which of the following solutions contains the lowest concentration of sodium ions (Na^+)?

- (a) 0.15 M Na_3PO_4
- (b) 0.40 M NaCl
- (c) 0.30 M NaBr
- (d) 0.20 M Na_2SO_4

10- The volume of water required to dilute 1 Liter of solution from 0.3 molar To 0.1 M equal.....

- (a) 1 L
- (b) 1.5 L
- (c) 2 L
- (d) 3 L



Weekly assessment (Week-4)

Question (1):-

1- "The relationship $M_1 \times V_1$ (before dilution) = $M_2 \times V_2$ (after dilution) is used to calculate the concentration of the solution after dilution, despite the change in concentration".

- Explain the previous statement in light of your studies.

2- One of your friends added 147.35 gm of glucose sugar to 150 mL of water, resulting in a saturated 5.05 M solution (molar mass of glucose=180 g/mol)

-How many milliliters of water would you advise your friend to add to dissolve the remaining glucose without changing the concentration of the solution?

3- 15 ml of 0.2 M hydrochloric acid solution is added to 0.212 gm of sodium Carbonate according to the following equation: (Na=23 , C = 12 , O=16)



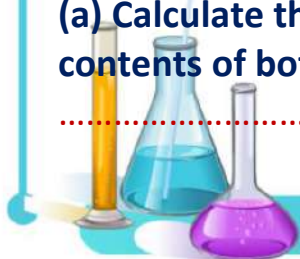
-Calculate the concentration of formed sodium chloride in the solution.

Question (2):-



1- From the previous figure:-

(a) Calculate the concentration of the solution resulting from adding the entire contents of both bottles to the glass beaker.



(b) Calculate the concentration of ions in the produced solution in the glass beaker.

(C) How many moles of sulphuric acid required to neutralize the produced solution in the beaker?

2- How many grams of barium chloride (BaCl_2) are needed to obtain 500 mL of a solution with a chloride ion concentration of 0.5 M? ($\text{Ba}=137$, $\text{Cl}=35.5$)

3- How many moles of anions dissolved in 100 mL, 0.1M aluminum chloride solutions?

Question (3):-

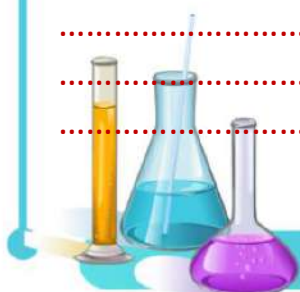
1- Calculate the molarity of each of the following:

(a) Ions produced by dissolving 14.2 gm of sodium sulfate in 100mL of pure water. ($\text{Na}=23$, $\text{S}=32$, $\text{O}=16$)

(b) Solution of aluminum sulfate with an ions molarity of 0.2M.

(c) Solution produced by dissolving 17 gm of silver nitrate in 500 mL of Distilled water. ($\text{Ag}=108$, $\text{N}=14$, $\text{O}=16$)

(d) Cations in a molar solution of copper sulfate



Question (4):- Choose the correct answer:-

1-By dilution of sulphuric acid solution from 1M to 0.5M so the number of Moles will.....

- (a) Decrease to half
- (b) Decrease to quarter
- (C) Remain the same
- (d) Increase to twice

2- Volume (V) of a sodium sulphate solution, its concentration = (M) , its volume is tripled by distilled water, so the concentration of sodium ions in the resulting solution =

- (a) M/3
- (b) M/2
- (C) M/4
- (d) 2M/3

3- The volume of water required to dilute 1L sodium chloride solution from 0.3 M to 0.1 M equal.....

- (a) 1 L
- (b) 1.5 L
- (C) 2 L
- (d) 3 L



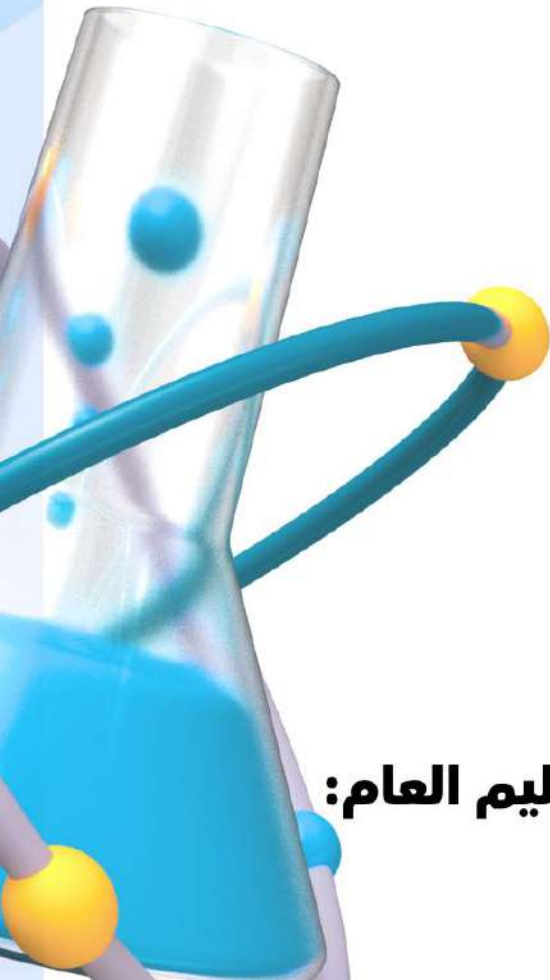
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2026

week

5

Home performance (Week 5)

Q1/ choose the correct answer:-

1- What phenomenon did Thomson's model fail to explain, which was the Basis for the development of Rutherford's model?

- (a) The deflection of a beam of electrons in the presence of a magnetic field.
- (b) The emission of specific colors (line spectrum) when atoms are heated.
- (c) The passage of most alpha particles through a gold foil with a small fraction Of them being deflected at large angles.
- (d) The dual nature of the electron, which is considered a charged particle with Wave properties.

2- Assuming that Thomson's model was correct, and alpha particles were fired at gold foil, what would be the main factor causing a slight deflection of the alpha particles?

- (a) The force of direct collision between the alpha particles and the electrons Embedded within it.
- (b) The repulsive force between the positively charged alpha particle and the High-density nucleus.
- (C) The repulsion between the alpha particles and the like charges on the atom.
- (d) The absence of a vacuum in the atom, forcing the alpha particle to pass Through the it.

3- If you know that gold alloy is considered a solid solution, the electrons in the Thomson model are similar to

- (a) The solvent.
- (b) The solute.
- (C) The alloy.
- (d) The crystal lattice of the alloy

4- Which of the following characteristics apply to the Thomson atomic model?

- 1- The nucleus is located at the center of the atom.
- 2- Electrons are spread throughout the atom.
- 3- The nucleus is positively charged.
- 4- The atom may be electrically neutral.

- (a) 1 and 3
- (b) 1 and 4
- (c) 2 and 4
- (d) 3 and 5

5-Which of the following particles is not affected by an electric field?

- (a) Beta particles
- (b) Alpha particles (${}_2\text{He}$)
- (c) Helium atoms (${}_2\text{He}$)
- (d) Electrons



(6) Which of the following observations in Rutherford's experiment proves that most of the atomic mass is concentrated in a very small part in it?

- (a) The appearance of a large number of flashes at the same place on the metal Plate before the gold foil was placed.
- (b) The appearance of flashes on the metal plate on both sides of the first position Before the placing gold foil.
- (c) The appearance of a very small number of flashes on the metal plate in front of The gold foil as a result of the reflection of alpha particles
- (d) The appearance of a large number of flashes on the metal plate in front of the Gold foil as a result of the reflection of alpha particles

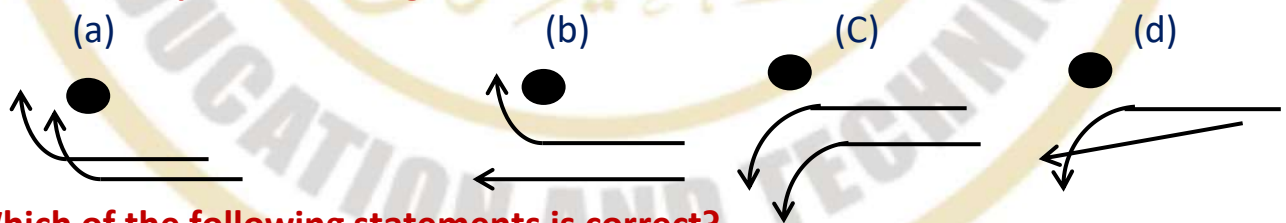
(7) If the gold foil ($_{79}\text{Au}$) in Rutherford's experiment is replaced with aluminum foil ($_{13}\text{Al}$), which of the following expresses the change in observations?

- (a) The alpha particle deflection rate increases and the deflection angle increases.
- (b) The alpha particle deflection rate decreases and the deflection angle increases.
- (c) The alpha particle deflection rate increases and the deflection angle decreases.
- (d) The alpha particle deflection rate decreases and the deflection angle decreases.

(8) What factor determines the value of the deflection angle of the alpha Particle in the Rutherford experiment?

- (a) The thickness of the target slice
- (b) The mass number of the alpha particle
- (c) The charge of the nucleus (atomic number Z)
- (d) The number of electrons orbiting the nucleus.

9- Which of the following represents the progress of two radiations of alpha particle when exposed to a large nucleus?



10- Which of the following statements is correct?

- (a) The Rutherford model is called the solar model, and the Thomson model is called the plum pudding model.
- (b) The Rutherford model and the Thomson atomic model are called the solar model.
- (c) Rutherford's model is called the plum pudding model and Thomson's Model is called the watermelon model.
- (d) Rutherford's model is called the watermelon model and Thomson's model is called the plum pudding model.



Weekly assessment (Week-5)

Question (1):-

(1) Suppose you are given a chance to repeat Rutherford's experiment by using a thin solid hydrogen foil instead of gold. Compare between your experience and the experience of Rutherford in the term of:-

- (a) Angle of deviation of alpha particles
- (b) Number of penetrate alpha particles

(2) What conclusion did Rutherford reach from each of the following Observations?

- 1- Very few alpha particles were reflected when the gold foil was placed.
- 2- Flashes appeared on both sides of the original position where they appeared Before the gold foil was placed.
- 3- A very large proportion of flashes appeared at the same position where they Appeared before the gold foil was placed.

(3) Mention the observation that leads to each of the following conclusions from Rutherford's experiment:

- 1- Most of the atom is empty space and not solid.
- 2- There is a very small, dense particle in the center of the atom called the nucleus.
- 3- The nucleus is a positively charged.

Question (2):- Mention the scientific reason for each of the following:-

- 1- The metal plate used in Rutherford's experiment is coated with zinc sulphide.
- 2- Both electrons and alpha particles are affected by the electric field.



3- The Rutherford model is called the solar model, while the Thomson model can be described as the plum pudding model

.....

.....

.....

Question (3):- Assisted by schoolbook

"If you know that Ernest Rutherford discovered alpha particles as a type of radiation emitted by radioactive elements (such as uranium and radium)."

1- Did Rutherford discover alpha radiation in 1899 or 1911?

.....

.....

2- Did Rutherford discover that alpha particles are positive helium nuclei 1899 or 1911?

.....

.....

3- Were electrons discovered as one of the components of the atom before or After 1911?

.....

.....

Question (4):- Mention the name of the scientist:-

1- The first to discover the existence of electrons as one of the components of the Atom ()

2- The first to discover the existence of a positive nucleus in the atomic structure ()

3-The first to assume that the atom is electrically neutral ()



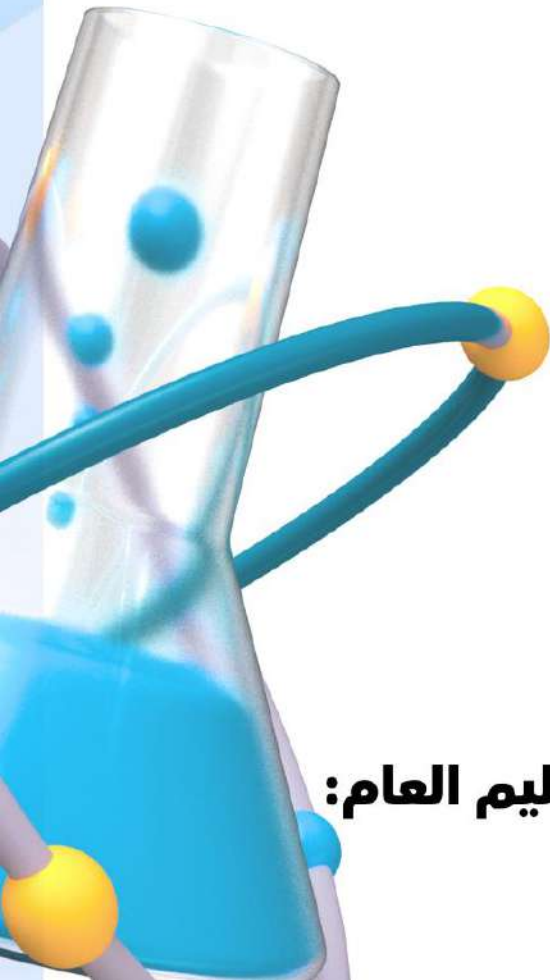
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CHEMISTRY

2nd secondary
first term

HOME PERFORMANCE



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2026

week

6

Home performance (Week 6)

Q1/ choose the correct answer:-

1- What happens to the energy required to excite an electron from level (n) To level (n+1) as the value of (n) increases?

- (a) The energy required for the transition decreases.
- (b) The energy required remains constant.
- (c) It is equal to the energy required for the transition from (n=1) to (n=2).
- (d) The energy required for the transition increases

2- If an electron moves from level (n=5) to level (n=1) and then returns to level (n=3), to which level must the electron return in order to emit a visible photon?

- (a) To level (n=4)
- (b) To level (n=1)
- (c) To level (n=3)
- (d) To level (n=2)

3- All of the following were later modified in the Bohr model due to the model's Inability to explain certain phenomena and concepts, except for?

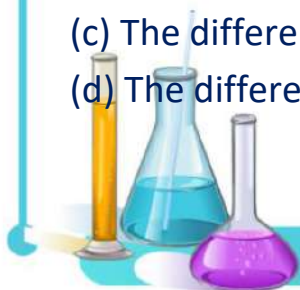
- (a) Electrons are only material particles
- (b) Electrons revolve in specific orbits
- (c) Atoms are flat and not three-dimensional
- (d) It is not possible to determine the speed and location of an electron at the Same time

4- The amount of energy required to transfer an electron from the first level (K) To the third level= (M)

- (a) Half a quantum
- (b) One quantum
- (c) 2 quanta
- (d) 3 quanta

5- The linear spectrum differs from one element to another due to.....

- (a) The difference in the number of neutrons in each.
- (b) The difference in the atomic number of each.
- (c) The difference in the mass number of each.
- (d) The difference in the number of valence electrons in each.



6- According to Bohr model, which of the following is necessary for an Electron transition from the second level ($n=2$) to the fourth level ($n=4$)?

- (a) It must lose an amount of energy equal to the difference between the Energies of the two levels.
- (b) It must gain an amount of energy equal to the difference between the Energies of the two levels.
- (c) It must lose an amount of thermal energy equal to the difference between The energies of the two levels.
- (d) It must gain an amount of energy greater than the difference between the Two levels.

7 - The spectral lines resulting from the return of electrons in hydrogen Atom to the first level is located in which region of the spectrum?

- (a) The infrared region.
- (b) The radio wave region.
- (c) The visible region.
- (d) Ultraviolet region.

8 - To obtain the visible spectrum of hydrogen atom for an electron excited To the second level (L), this electron must

- (a) Gain more energy and move to a higher level, then return to a stable state (Ground state).
- (b) Gain more energy and move to a higher level, then lose less energy than The total energy gained.
- (c) Gain more energy and move to a higher level, then lose energy equal to the Total energy gained.
- (d) Gain more energy and move to a higher level, then lose energy greater than The total energy gained.

9- All of the following cannot have a value of Zero except

- (a) Quantum
- (b) Principal quantum number (n)
- (c) Number of protons
- (d) Number of neutrons

10- The spectral lines resulting from the return of electrons in hydrogen Atom to the third level is located in which region of the spectrum?

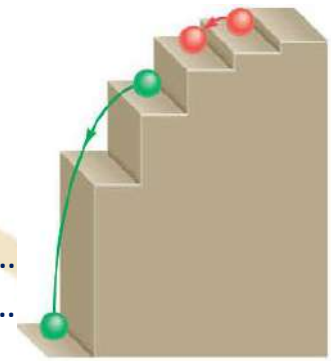
- (a) Infrared region.
- (b) Radio wave region.
- (c) Visible region.
- (d) Ultraviolet region.



Weekly assessment (Week-6)

Question (1):-

(1) The energy levels in Bohr's atomic model can be Expressed as steps on a stair, as shown in the figure, Where the ball does not settle between the steps of the Stair... Explain the previous statement.

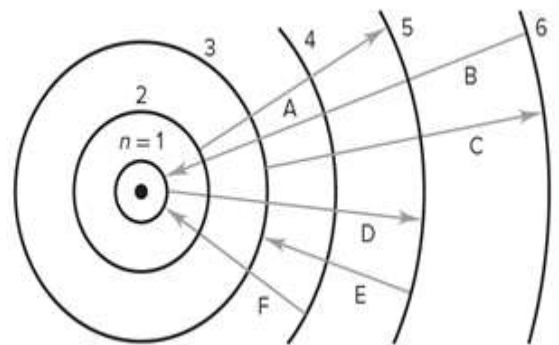


(2) The figure opposite shows Bohr's model of the hydrogen atom with several Electronic transitions indicated by arrows.

(a) Which transitions represent energy Emission and which represent energy absorption?

(b) Which electronic transitions exhibit the Highest energy absorption (A or C) and why?

(c) How much quantum is required for electronic transition (D)?



Question (2):- Mention the scientific reason for each of the following:-

1- Quantum is indivisible and does not multiply.

2- The visible spectrum of hydrogen consists of only four lines.

3- Using a spectrometer, it was determined that hydrogen gas is one of the basic Components of the sun.



Question (3):-

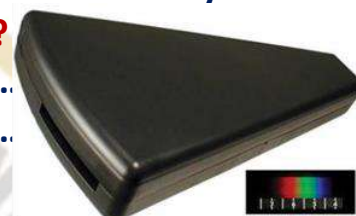
1- Does the corresponding figure represent the visible linear spectrum of a Hydrogen atom?

-Explain the scientific basis for your answer.



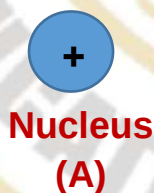
2. "The corresponding Image of a spectrometer used in atomic spectrum analysis"

- Can this device be used to identify the type of element, and why?



3- Study the figures in front of you, which represent the energy levels around the nucleus, then answer the following questions:

Q _____
O _____
N _____
M _____
L _____
K _____



Q _____
P _____
O _____
N _____
M _____
L _____
K _____



- 1- Which of the above figures represents Bohr's calculations of the energy Differences between levels as we move away from the nucleus, and why?
- 2- According to your choice in the first question, which quantum has a higher Value: the quantum required transferring an electron from the first level to the Second Level, or the quantum released by the transfer of an electron from the Fourth level to the third level?
- 3- What is the relationship between the energy of a given level and its radius?



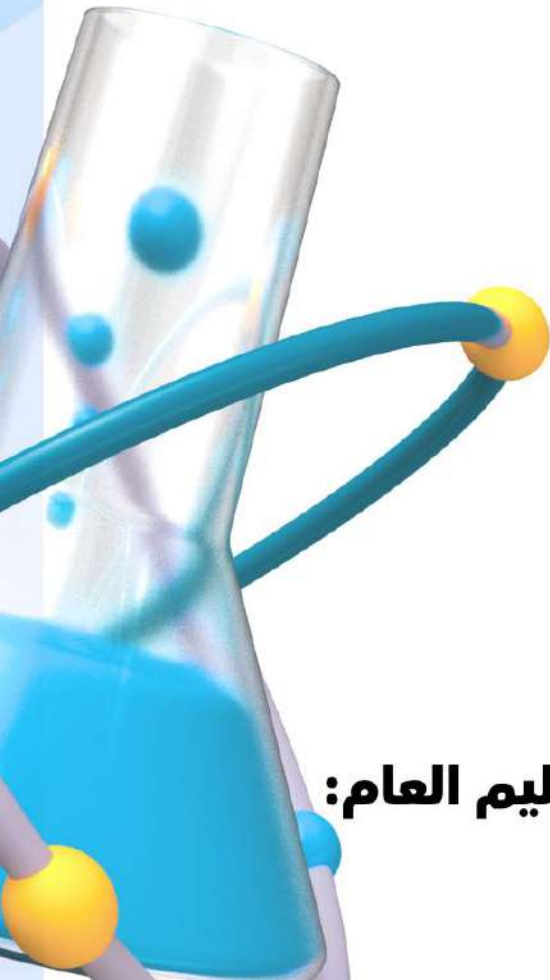
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CHEMISTRY

2nd secondary
first term

HOME PERFORMANCE



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2026

week

7

Home performance (Week 7)

Q1/ Choose the correct answer:-

1- All the following are characteristics of electrons, except

- (a) They are material particles.
- (b) They have wave properties.
- (c) They lose energy when they move from one energy level to another.
- (d) They are affected by electric and magnetic fields.

2- Heisenberg's uncertainty principle applies to.....

- (a) Protons.
- (b) Neutrons.
- (c) Electrons.
- (d) All atomic particles.

3- Which of the following choices is saturated with the largest number of electrons?

- (a) orbital of 4f sublevel
- (b) 2P sublevel
- (c) Energy level (n=2)
- (d) 3d sublevel

4. Which of the following formulae can be used to calculate the number of electrons needed to fill the subshell?

- (a) n^2
- (b) $2n^2$
- (c) $2(2\ell+1)$
- (d) $(2\ell+1)$

5-Which of the following choices expresses the four quantum numbers of an electron in the 2Py orbital?

choices	n	ℓ	$m\ell$	m_s
a	2	1	-1	+1/2 or -1/2
b	1	1	0	+1/2 or -1/2
c	2	2	+1	+1/2 or -1/2
d	2	1	0	+1/2 or -1/2

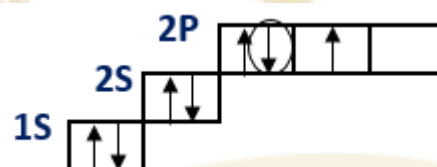


6- Which of the following choices equals the number of orbitals that can be occupied by an electron with principal quantum number ($n=5$) and magnetic quantum number ($m_l = -2$)?

- (a) 1
- (b) 2
- (c) 3
- (d) 4

7- Which of the following choices represents the four quantum numbers for the electron in the circle?

choices	n	ℓ	m_ℓ	m_s
a	1	0	-1	-1/2
b	2	1	-1	-1/2
c	2	1	+1	-1/2
d	2	1	1	+1/2



8- Which of the following choices does not describe the electron cloud and orbital?

choices	Orbital	Electron cloud
a	The region of space surrounding the nucleus where electrons are most likely to be found 90% to 95% The region of	An area of a region of space surrounding the nucleus where electrons are likely to be found.
b	It has a specific shape and size.	It has a specific shape and size It has no clear and specific boundaries and represents the total distribution of electron density
c	It is part of the electron cloud	It is the sum of all orbitals at an energy level
d	It represents a low probability of the electron being present in a wide range	It represents the highest probability density of the electron being present.

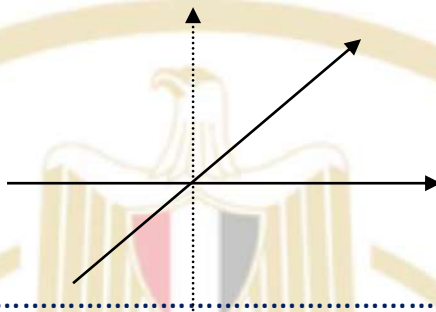




Weekly assessment (Week-7)

Question (1):-

1-The following figure represents three dimensions (X, Y, Z). Draw the orbital - shapes in the main plane (n=2).



2- Complete the following table:

<u>n</u>	<u>ℓ</u>	<u>mℓ</u>	<u>m_s</u>	<u>Orbital</u>							
2	1	-1	+1/2	2P <table border="1"><tr><td>↑</td><td></td><td></td></tr></table> (example)	↑						
↑											
1			-1/2	1S <table border="1"><tr><td>...</td></tr></table>	...						
...											
4	3			 <table border="1"><tr><td></td><td>↑</td><td></td><td></td><td></td><td></td><td></td></tr></table>		↑					
	↑										
3		-2	+1/2	 <table border="1"><tr><td></td><td></td><td></td><td></td><td></td></tr></table>							

3- Which one is saturated with a greater number of electrons, energy level (P) or energy level (p)? Why?

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.....

.....

.....

.....

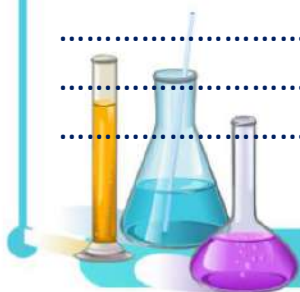
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Question (2):- State the scientific reason for each of the following:

1- The rule $2n^2$ does not apply to levels after the fourth.

.....

.....

.....

2- The f sublevel is filled with 14 electrons.

.....

.....

.....

3- There is no (2d) sublevel in the atom.

.....

.....

.....

4- The number of electrons required to fill the principle level can be calculated using the $2n^2$ rule.

.....

.....

.....

Question 3:

1- Write the possible values for Each (ℓ and $m\ell$) for electron (n) = 3.

.....

.....

.....

2- Compare the second and third main energy levels in terms of:

- (a) Their symbols
- (b) The number of electrons needed to saturate each
- (c) Their sublevels
- (d) The number of orbitals in each
- (e) Their radius
- (f) Their energy

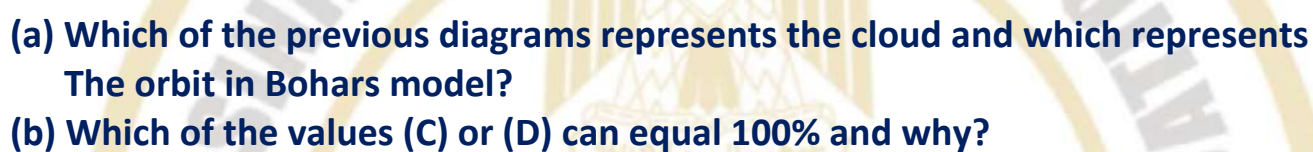
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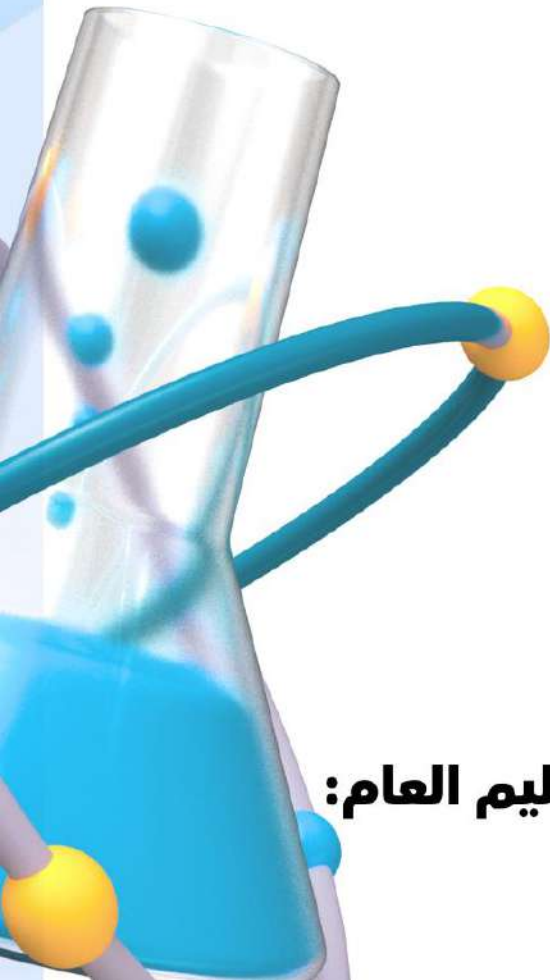
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CHEMISTRY

2nd secondary
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HOME PERFORMANCE



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2026

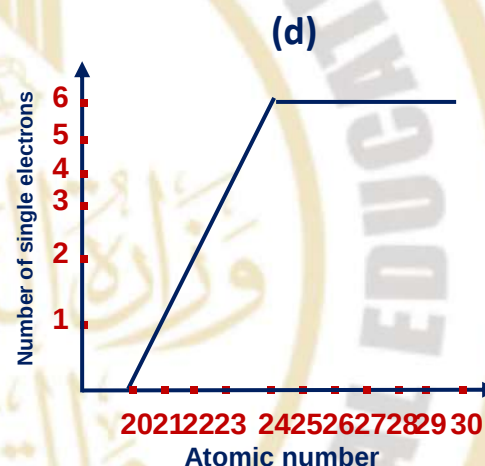
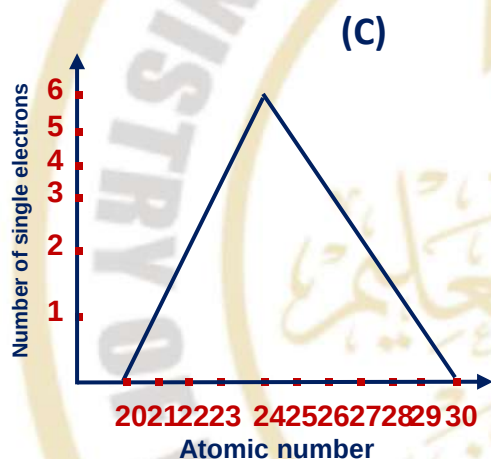
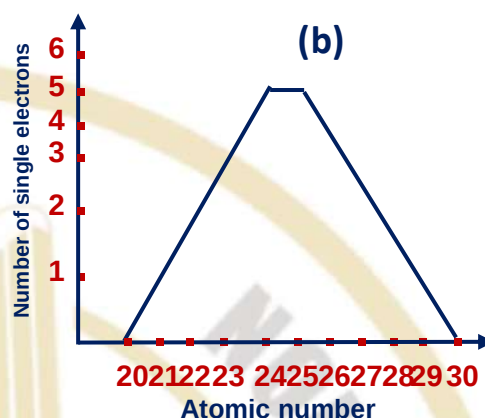
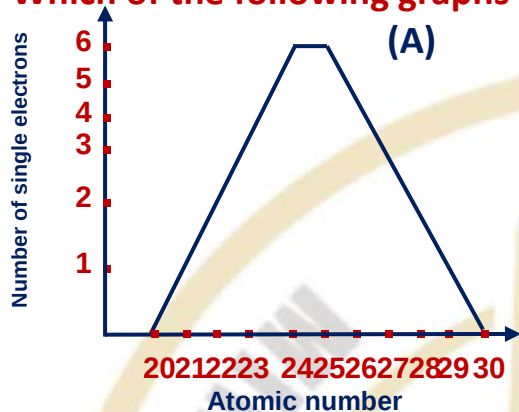
week

8

Home performance (Week 8)

Q1/ Choose the correct answer:-

1-Which of the following graphs is correct?

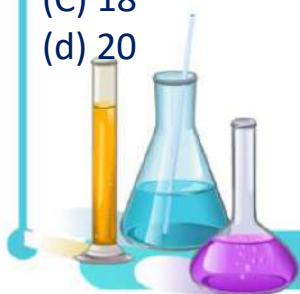


2- An element (X) contains number of electrons in sublevel (4s) equal to number of electrons in (3d), so the electronic configuration of (X^{2+}) is:

- (a) $1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2, 3d^2$
- (b) $1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2$
- (c) $1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 3d^2$
- (d) $1s^2, 2s^2, 2p^6, 3s^2, 3p^6$

3- The element in which all its electrons are distributed in six completed energy sublevels, its atomic number =

- (a) 1
- (b) 10
- (c) 18
- (d) 20



4- Atom of an element contain one single electron in (p) sublevel, so its atomic number equal

- (a) 12 or 15
- (b) 31 or 17
- (C) 14 or 15
- (d) 11 or 14

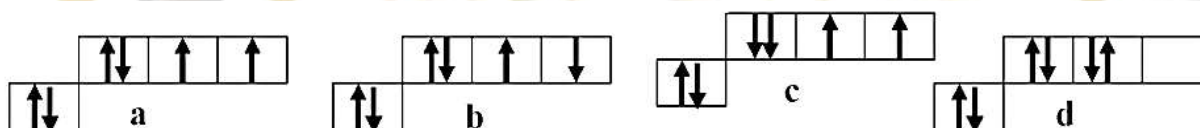
5-The four quantum numbers of the last electron in an atom ($n=3$, $\ell=2$, $m\ell= -2$, $m_s= +1/2$) so its atomic number :

- (a) 11
- (b) 17
- (C) 21
- (d) 26

6-Which of the following represents the number of orbitals partially filled with electrons for an element with atomic number 19?

- (a) 1
- (b) 7
- (c) 10
- (d) 15

7-Which of the following diagram shows the correct distribution of electrons in the last energy level of oxygen atom?



8- If you know that the sum of spin quantum numbers of electrons of an Element = 3, then the atomic number of the element is.....

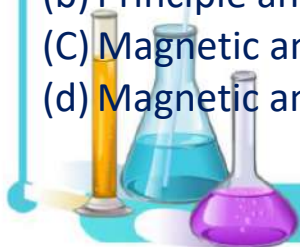
- (a) 24
- (b) 25
- (C) 26
- (d) 27

9- Electronic distribution of (X^{1+}) ion whose nucleus contains 29 protons:

- (a) $1S^2, 2S^2, 2P^6, 3S^2, 3p^6, 3d^9$
- (b) $1S^2, 2S^2, 2P^6, 3S^2, 3p^6, 4S^2, 3d^8$
- (C) $1S^2, 2S^2, 2P^6, 3S^2, 3p^6, 3d^{10}$
- (d) $1S^2, 2S^2, 2P^6, 3S^2, 3p^6, 4S^1, 3d^{10}$

10- What are the quantum numbers whose value never be negative?

- (a) Principle and subsidiary
- (b) Principle and spin
- (C) Magnetic and subsidiary
- (d) Magnetic and spin



Weekly assessment (Week-8)

Question (1):- State the scientific reason for each of the following:

1- The (s) subshell fills with electrons before (d) subshell, even though it is Farther from the nucleus.

.....

2-Electrons prefer to singularly distribute in the orbitals of the same sublevel first.

.....

3- The paired electrons in the same orbital don't repel in although their same Negative charge.

.....

4- Although the values of $(n + \ell)$ for both subshells (4p) and (3d) are equal, the Energy of (4p) is higher.

.....

5- The element chromium ($_{24}\text{Cr}$) has an abnormal electron distribution.

.....

6- The copper element ($_{29}\text{Cu}$) has an abnormal electron distribution.

.....

Question (2):

1- An element its third energy level contains numbers of electrons equals the sum of electrons in first and second energy levels.

-Apply Pauli Exclusion Principle on valences electrons.

.....

2- The four quantum numbers for the valance electron of an atom are $(n = 4, \ell = 0, m_{\ell} = 0, m_s = -1/2)$, and The number of electrons in the third energy level is the sum of the number of electrons in the first and second energy levels. Write the Electronic configuration for this element and for its $2+$ ion.

.....

.....



3- Determine the possible four quantum numbers of the furthest electrons in scandium atom $_{21}\text{Sc}$.

.....

.....

4 - An element contains one electron in the last sublevel , if the quantum numbers of that electron are : ($n = 3$, $\ell = 1$, $m_\ell = -1$, $m_s = +\frac{1}{2}$) .

-Calculate the atomic number of the element.

.....

.....

Question (5) Choose the correct answer :

1- What is the number of the electrons which have magnetic quantum number $m_\ell = 0$ in cobalt (II) ion $_{27}\text{Co}^{2+}$?

- (a) $7 e^-$
- (b) $8 e^-$
- (c) $10 e^-$
- (d) $11 e^-$

2- The total number of the orbitals which are filled with electrons in the two energy levels (M + L) of the atom of argon $_{18}\text{Ar}$ is

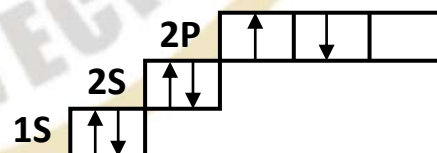
- (a) 4
- (b) 8
- (c) 9
- (d) 13

3- The number of half-filled orbitals in the element whose atomic number (42) = ...

- (a) 4
- (b) 6
- (c) 2
- (d) 5

4- What is the incorrect about this orbital diagram?

- (a) Both arrows in the 2P box should be pointing up
- (b) There is nothing incorrect with this diagram
- (c) In the 2P box there should be 2 electrons in the first box
- (d) All the arrows should be pointing up



5- The number of electrons of an atom in a certain element containing first four full-filled Sublevels and one half filled Sublevel equals

- (a) 7
- (b) 10
- (c) 15
- (d) 18



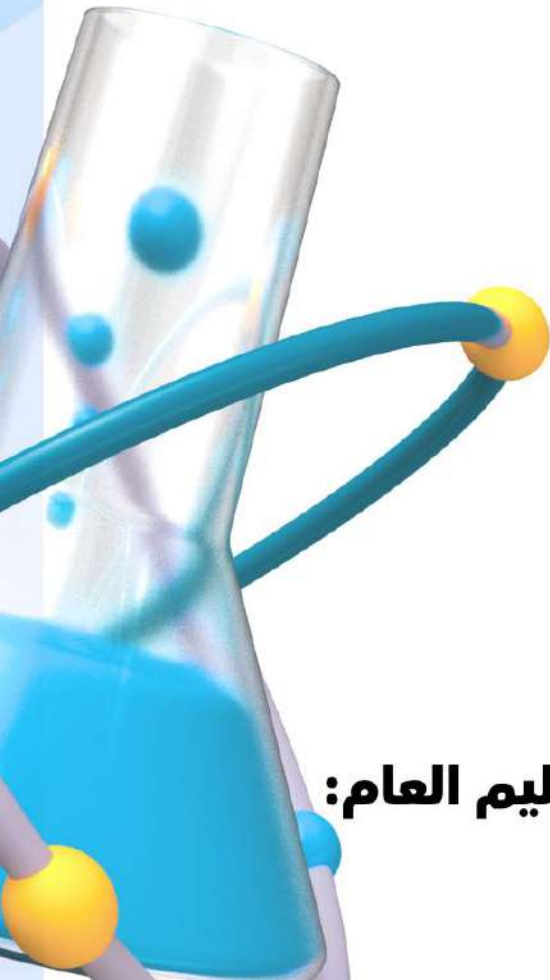
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CHEMISTRY

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HOME PERFORMANCE



إعداد:

أ. سامح منصور

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مستشار مادة العلوم:

د. عزيزة رجب خليفة

رئيس الإدارة المركزية للتعليم العام:

د. هالة عبدالسلام خفاجي

2026

week

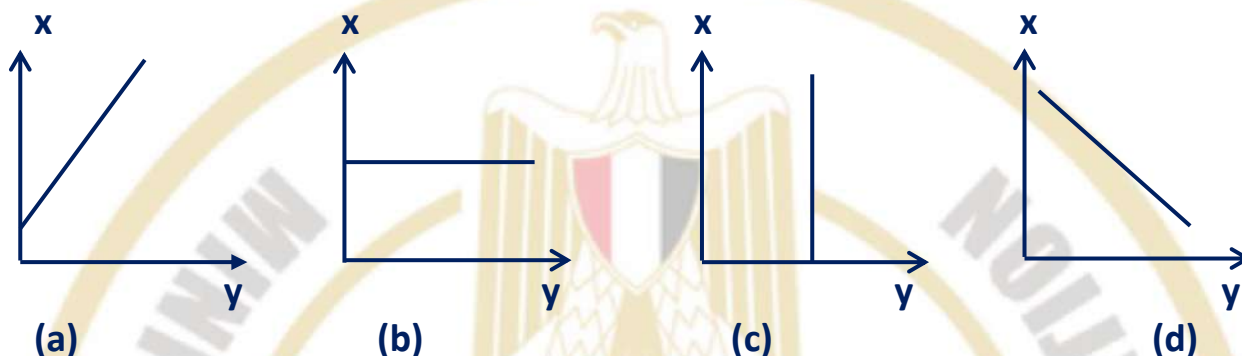
9

Home performance (Week 9)

Q1/ Choose the correct answer:-

1- Which graph in front of you represents the relation between atomic number and number of electron in valence shell in group 2A?

(x) Axis represent atomic number , (y) axis represent valences electrons



2- Two elements (X) and (Y) are successive elements in periodic table, the four Values of quantum number for last electron of element (X)

$[n=2, \ell=1, m_{\ell}=+1, m_s=-1/2]$, So the four quantum number of last electron of element (Y)

- (a) $n=2, \ell=1, m_{\ell}=+1, m_s=+1/2$
- (b) $n=2, \ell=0, m_{\ell}=0, m_s=+1/2$
- (c) $n=3, \ell=0, m_{\ell}=0, m_s=-1/2$
- (d) $n=3, \ell=0, m_{\ell}=0, m_s=+1/2$

3- Elements (X) its electronic configuration $[\text{Xe}] 6s^2 4f^{14} 5d^2$ it lies in Period.....group.....

- (a) 6 , 4B
- (b) 6, 5A
- (c) 4 , 6B
- (d) 6, 4B

4-The electronic configuration of an element is $[\text{Xe}] 6s^2 4f^7 5d^1$, its type is.....

- (a) Main transition - 3rd series
- (b) Inner transition - lanthanide
- (c) Representative
- (d) Inner transition- actinides

5-Element (Y) has a mass number of 19 and a protons number of 9.

-Which group in the periodic table does it belong to?

- (a) Group 1
- (b) Group 17
- (c) Group 7
- (d) Group 13



Element	Electronic structure
R	$1S^2, 2S^2, 2P^5$
T	2, 8
X	$1S^2, 2S^2, 2P^6, 3S^2$
Z	2, 8, 7

- (a) R and T
(b) T and X
(c) X and Z
(d) Z and R

7- Properties of phosphorus element [$_{15}\text{P}$] similar to the element whose quantum numbers for the last electron are.....

- (a) $n=3, \ell=2, m_\ell=+1, m_s=-1/2$
 (b) $n=4, \ell=0, m_\ell=-1, m_s=-1/2$
 (c) $n=3, \ell=1, m_\ell=+1, m_s=+1/2$
 (d) $n=2, \ell=1, m_\ell=+1, m_s=+1/2$

8- An element its electronic configuration end with $(6S^2, 4F^7, 5d^1)$, so this element from

- (a) transition in the fourth period
- (b) transition in the fifth period
- (c) Inner transition elements (Actinides)
- (C) Inner transition elements (Lanthanides)

9-

[illegible]

-Which of the following statements is correct?

- (a) L, M and Q are representative elements.
(b) L, M, R and T are representative elements.
(c) L, M and R are representative elements.
(d) R and T are noble gas.





Weekly assessment (Week-9)

Question (1):- the scientific reason for each of the following:

1- s-Block consists of two groups of elements.

2- There are no p-block elements in the first period of the periodic table.

3-The d-block consists of 10 vertical columns.

4-The f-block contains twenty eight elements.

5- Elements of the same group are similar in their chemical properties.

Question (2):

(1) Locate the block and type of the elements , which have the following electronic configuration:

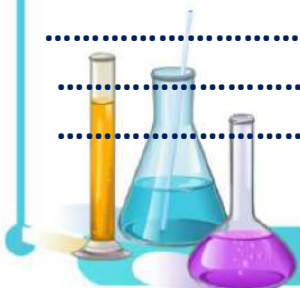
(a) $1s^2, 2s^2, 2p^3$

(b) $1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2, 3d^5$

(c) $1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2, 3d^{10}, 4p^6$

(2) Determine the four quantum numbers of the last electron that has the highest energy in lanthanum $_{57}\text{La}$, and then determine the position of this element in the periodic table?

(3) An element located in group 2A and period 4, Apply Pauli Exclusion Principle on the valences electrons.



(4) The penultimate main energy level element, which is the third, contains 14 electrons.

- Write the electron distribution for this element and for the element follow it in the same period.

Question (3):

Write the scientific term for each of the following statements:

1- Elements in which the (4f) sublevel is filled successively.

()

2- Elements in which the (5f) sublevel is filled successively.

()

3- Elements of the (s) and (p) blocks of the periodic table with the exception Of the noble gases.

()

4- Elements in which (d) sublevel is filled successively.

()

5- Elements of the f-block of the periodic table.

()

()



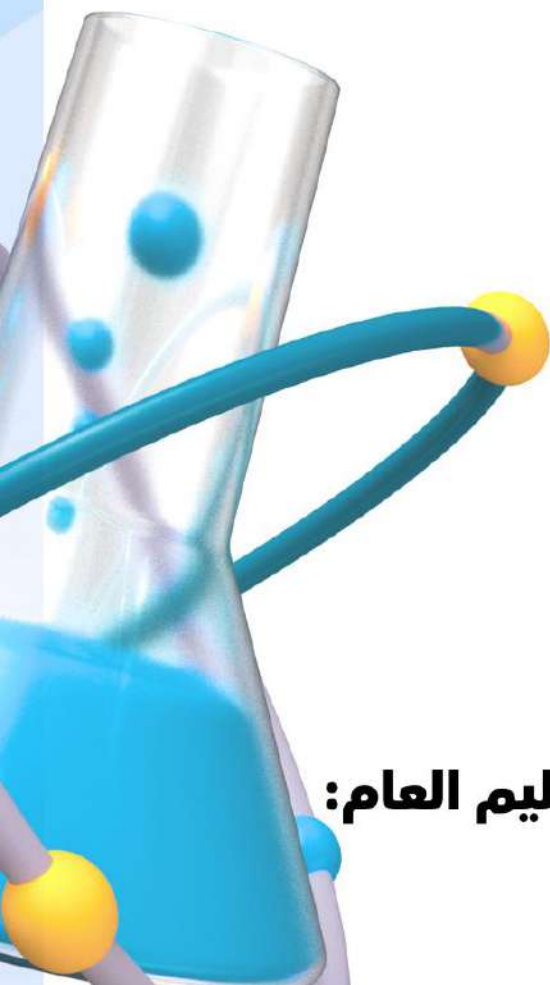
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CHEMISTRY

2nd secondary
first term

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10

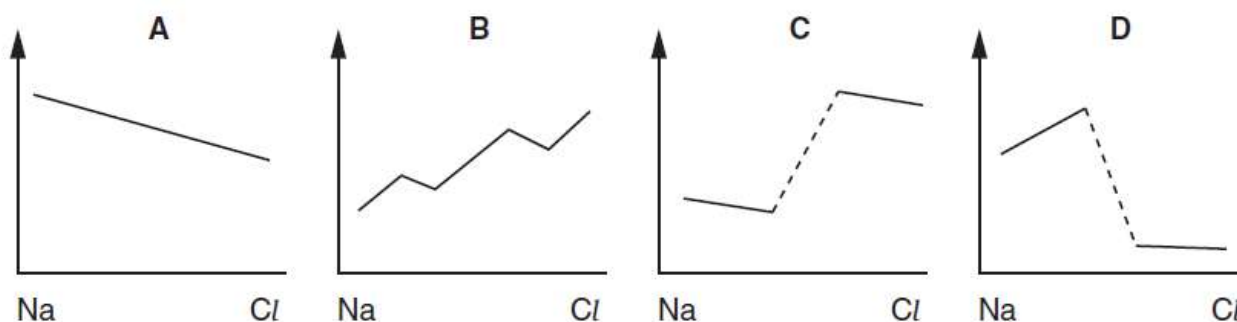
Home performance (Week 10)

Q1/ Choose the correct answer:-

1- The biggest atom in size in a given period is that of group.

- (a) IA (b) IB
(c) halogens. (d) 17

2- Which diagram represents the change in ionic radius of the elements across The third period (Na to Cl)?



3- Which series is arranged in order of increasing radius.....

- (a) $\text{Ca}^{2+} < \text{Cl}^- < \text{K}^+$
(b) $\text{K}^+ < \text{Ca}^{2+} < \text{Cl}^-$
(c) $\text{Ca}^{2+} < \text{K}^+ < \text{Cl}^-$
(d) $\text{Cl}^- < \text{K}^+ < \text{Ca}^{2+}$

4- The following table shows the atomic radii of four elements in the same period.

X	Y	W	Z
1.18 Å	2.27 Å	1.35 Å	1.14 Å

-Which of the previous element has the biggest atomic number?

- (a) X
(b) Y
(c) Z
(d) W

5- If you know that element (A) precedes element (B) in the same period and element (A) precedes element (C) in the same group , then the correct order according to their atomic radii is

- (a) $\text{C} < \text{A} < \text{B}$ (b) $\text{C} < \text{B} < \text{A}$
(c) $\text{B} < \text{C} < \text{A}$ (d) $\text{B} < \text{A} < \text{C}$



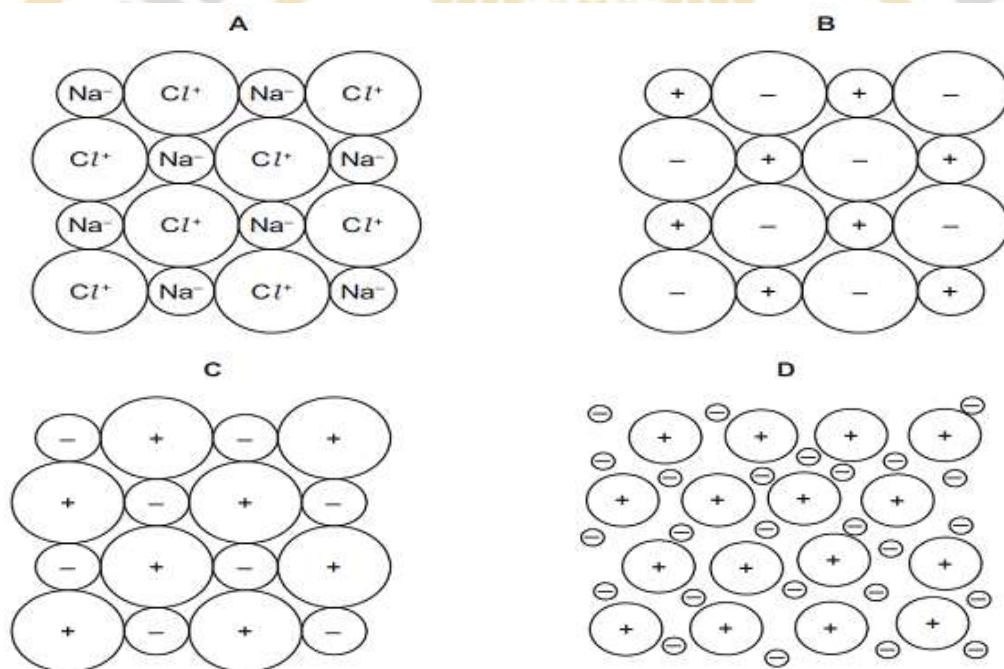
6-If the atomic radius of sodium $1.86 \text{ \AA}$, so the ionic radius of sodium ion may be

- (a) $1.96 \text{ \AA}$
- (b) $0.9 \text{ \AA}$
- (c) $1.86 \text{ \AA}$
- (d) $2.9 \text{ \AA}$

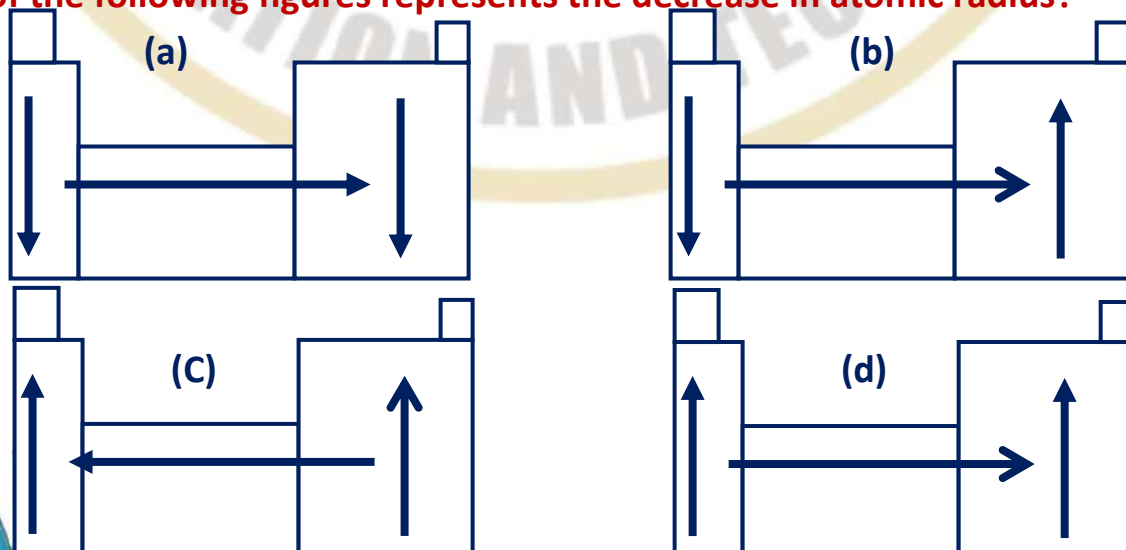
7-Which of the following its atomic radius is the smallest

- (a) $_{17}\text{Cl}$
- (b) $_{11}\text{Na}$
- (c) $_{9}\text{F}$
- (d) $_{7}\text{N}$

8- Which structure represents the sodium chloride lattice?



9- Which of the following figures represents the decrease in atomic radius?



	Smallest  Largest		
(a)	Na ⁺	F ⁻	Na
(b)	F ⁻	Na	Na ⁺
(c)	Na ⁺	Na	F ⁻
(d)	Na	F ⁻	Na ⁺



Weekly assessment (Week-10)

Question (1):- Write the scientific term for each of the following statements:

- (1) Half the distance between the centers of two similar atoms in a diatomic Molecule. ()
- (2) The actual charge of the nucleus that affects the electron ()
- (3) The radius of cation or anion ()

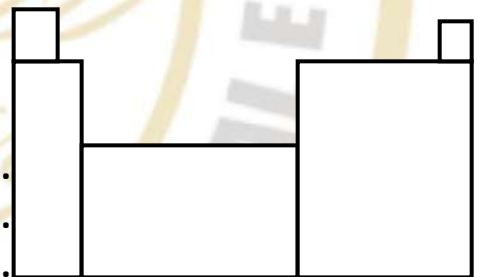
Question (2):-

(1) For each of the following pairs, select the one with the larger radius.

- a. $_{15}\text{P}$ or $_{17}\text{Cl}$
- b. $_{6}\text{C}$ or $_{35}\text{Br}$
- c. Cl^- or Cl
- d. Ni^+ or Ni^{2+}
- e. Br^- or Rb^+

(2) On the representation of the periodic table
Draw arrows to represent an increasing in
Atomic radius.

.....
.....
.....



(3) In the following figure, (A) is an element and (B) is an ion of the same Element. Is the ion (B) a positive or negative ion of atom A?



Explain your answer?

.....
.....
.....

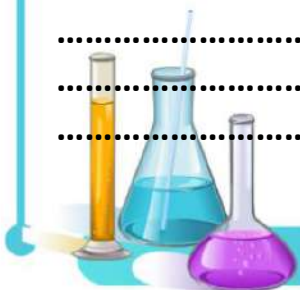


(2) The atomic radius in the same group increases as the atomic number increases.

(3) Atomic radius of chlorine atom ($_{17}\text{Cl}$) is smaller than that of sodium atom ($_{11}\text{Na}$).

(4) The ionic radius of a nonmetal is larger than its atomic radius while the ionic radius of a metal is smaller than its atomic radius.

(5) The ionic radius of iron III ion Fe^{3+} is shorter than that of iron II ion Fe^{2+}



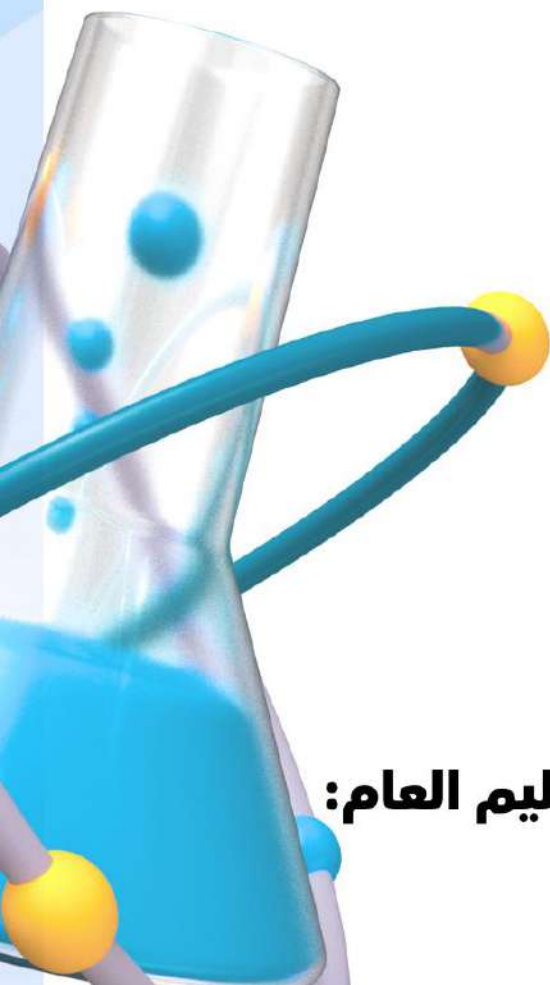
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week

10

Home performance (Week 10)

Q1/ Choose the correct answer:-

1- The electronegativity of elements in the horizontal cycle increases with an (a/an)

- (a) Decrease in an atomic radius.
- (b) Decrease in an atomic number.
- (c) Increase in an atomic radius.
- (d) A and B.

2- Which of the following elements has the highest first ionization energy?

- (a) $_{11}\text{Na}$
- (b) $_{17}\text{Cl}$
- (c) $_{12}\text{Mg}$
- (d) $_{18}\text{Ar}$

3- Which of the following elements has the highest electronegativity?

- (a) $_{11}\text{Na}$
- (b) $_{9}\text{F}$
- (c) $_{12}\text{Mg}$
- (d) $_{18}\text{Ar}$

4- Which of the following reactions requires the highest energy (highest ionization Energy)?

- (a) $\text{Na} \rightarrow \text{Na}^+ + \text{e}^-$
- (b) $\text{Na}^+ \rightarrow \text{Na}^{2+} + \text{e}^-$
- (c) $\text{Mg} \rightarrow \text{Mg}^+ + \text{e}^-$
- (d) $\text{Mg}^+ \rightarrow \text{Mg}^{2+} + \text{e}^-$

5- Which of the following elements has the highest first ionization energy?

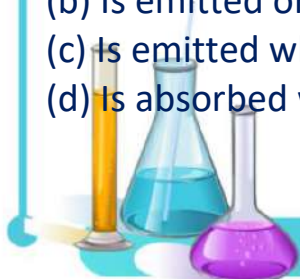
- (a) $_{3}\text{Li}$
- (b) $_{4}\text{Be}$
- (c) $_{5}\text{B}$
- (d) $_{11}\text{Na}$

6- Which of the following statements is generally correct when moving from Top to bottom in vertical group?

- (a) The ionization energy increases due to the increase in the effective charge of The nucleus.
- (b) The ionization energy increases due to the decrease in atomic size.
- (c) The ionization energy decreases due to the increase in atomic size.
- (d) The ionization energy decreases due to the decrease in the screening effect Of energy levels.

7- The electron affinity is the energy that:

- (a) Is absorbed when an electron is removed from an isolated gas atom
- (b) Is emitted or absorbed when an electron is added to an isolated gas atom
- (c) Is emitted when a proton is added to the nucleus of an atom
- (d) Is absorbed when a positive and negative ion are separated.



8-Elements (X) and (Y) are in the same group of the periodic table. The table shows the first ionization energies of (X) and (Y) in KJ/mol

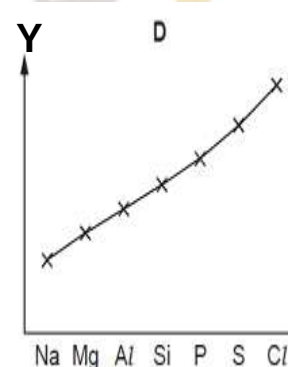
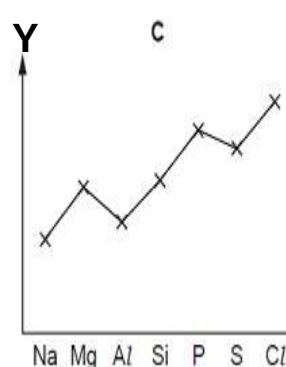
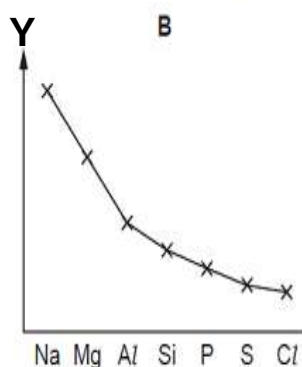
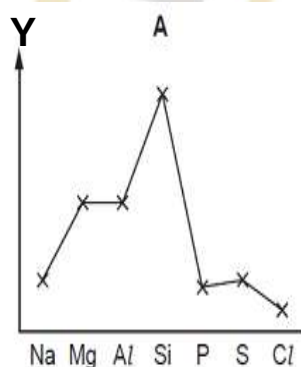
	1 st I.E	2 nd I.E	3 rd I.E	4 th I.E	5 th I.E	6 th I.E
X	800	1600	2400	4300	5400	10400
Y	1000	1800	2700	4800	6000	12300

-What could be the identities of (X) and (Y)?

	X	Y
A	Antimony, Sb	Arsenic, As
B	Arsenic, As	Antimony, Sb
C	Selenium, Se	Tellurium, Te
d	Tellurium, Te	Selenium, Se

9- The graphs show the progression of four physical properties of the elements in the third period, except for argon.

- Which graph shows electronegativity property on the Y-axis?

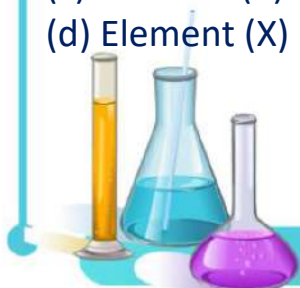


10- Two elements (X and Y) are in the same period. Their first, second, and third ionization energies are as follows:

	1 st I.E	2 nd I.E	3 rd I.E
X	577	1816	2744
Y	737	1450	7731

-Which of the following statements is correct?

- (a) Element (X) is in group IIA.
- (b) Element (Y) is in group IIIA.
- (c) Element (X) has a higher atomic number than element (Y).
- (d) Element (X) has a lower atomic number than element (Y).



Weekly assessment (Week-11)

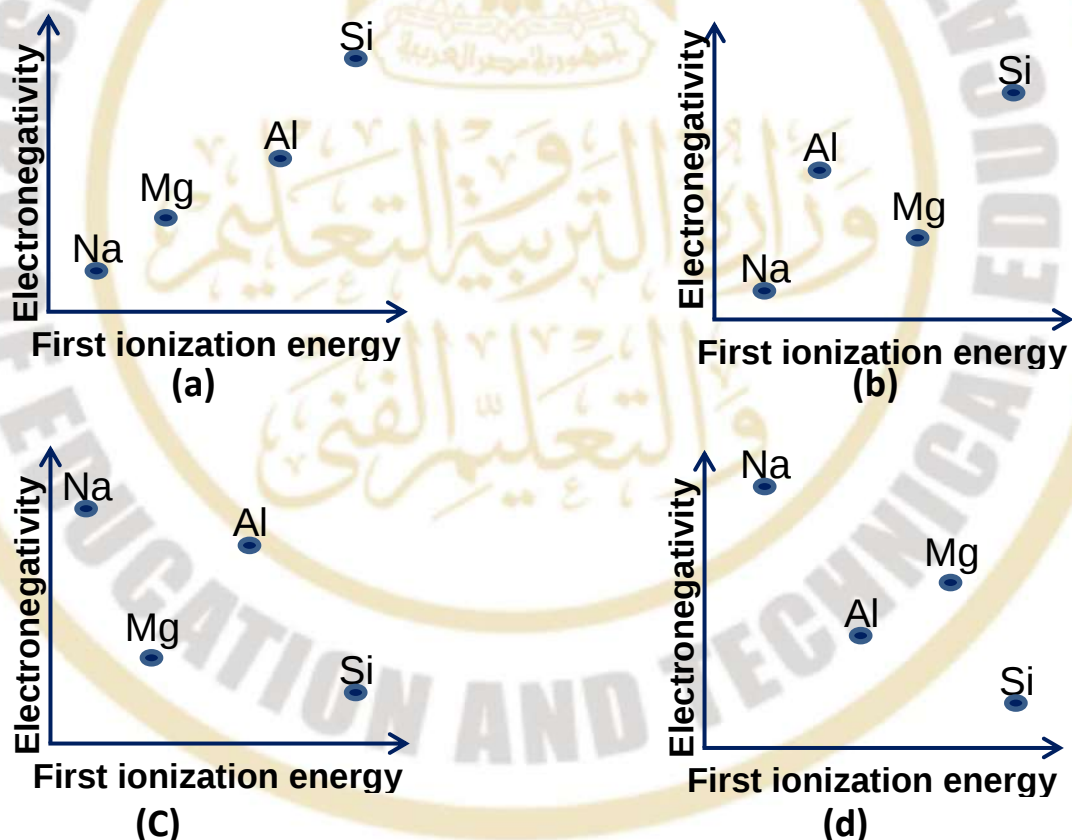
Question (1):- Choose the correct answer:

(1) The opposite table represents the electronic configuration of atoms and ions for some elements, which of the following is the correct order according to electronegativity?

- (a) $C < D < B < A$
- (b) $D < A < C < B$
- (c) $A < B < C < D$
- (d) $B < C < D < A$

Element or ion	Electronic structure
A^{-1}	[Ne]
B^{-2}	[Ne]
C	[Ar]4s ¹
D	[Ne]3s ¹

(2) Which diagram correctly shows the electronegativity of the elements Na, Mg, Al and Si plotted against their first ionization energies?



(3) Which of the following elements has the highest first ionization energy ?

- (a) $_{13}\text{Al}$
- (b) $_{11}\text{Na}$
- (c) $_{12}\text{Mg}$
- (d) $_{19}\text{K}$



(4) Element (X) has a higher first I.E than element (Y).

Two students state what they believe is one factor that helps to explain this.

- **Student (1):** (X) has a higher 1st I.E than (Y) because an atom of (X) has more Protons in its nucleus than an atom of (Y)

- **Student (2):** (X) has a higher 1st I.E than (Y) because (X) has a smaller atomic Radius than (Y)

-Only one of the two students is correct, what could (X) and (Y) be?

	X	Y
A	Carbon	Boron
B	Magnesium	Aluminum
C	Oxygen	Nitrogen
d	Oxygen	Sulphur

Question (2):-

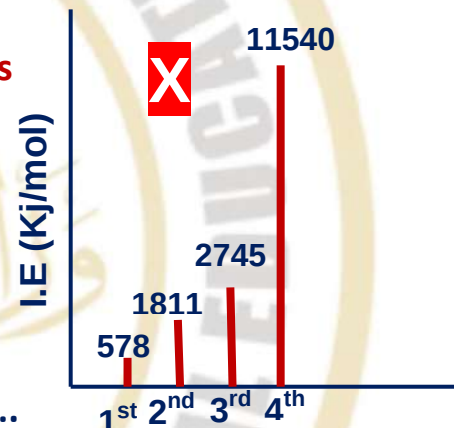
(1) The corresponding figure shows the ionization energies Of element (Y) in the third period:

(a) Write the electron configuration of atom (Y).

(b) Which has higher ionization energy, element (Y) or The element preceding it in the same period? Explain your answer.

(c) Which has higher ionization energy, element (Y) or the element that follows it in The same period? Explain your answer.

(d) Which has higher ionization energy, element (Y) or the element that below it in The same group?

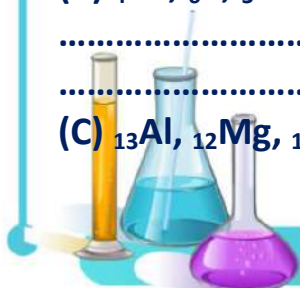


(2) Arrange the following elements in ascending order according to the property Indicated in Brackets:

(a) ${}_8\text{O}$, ${}_7\text{N}$, ${}_9\text{F}$ (atomic radius and first ionization energy)

(b) ${}_4\text{Be}$, ${}_6\text{C}$, ${}_5\text{B}$ (atomic radius and first ionization energy)

(c) ${}_{13}\text{Al}$, ${}_{12}\text{Mg}$, ${}_{14}\text{Si}$ (atomic radius and first ionization energy)



(2) The electron affinity value for nitrogen is positive.

(4) Ionization energy in a given group decreases with increasing atomic number.

(5) The second ionization energy is greater than the first ionization energy of The element.



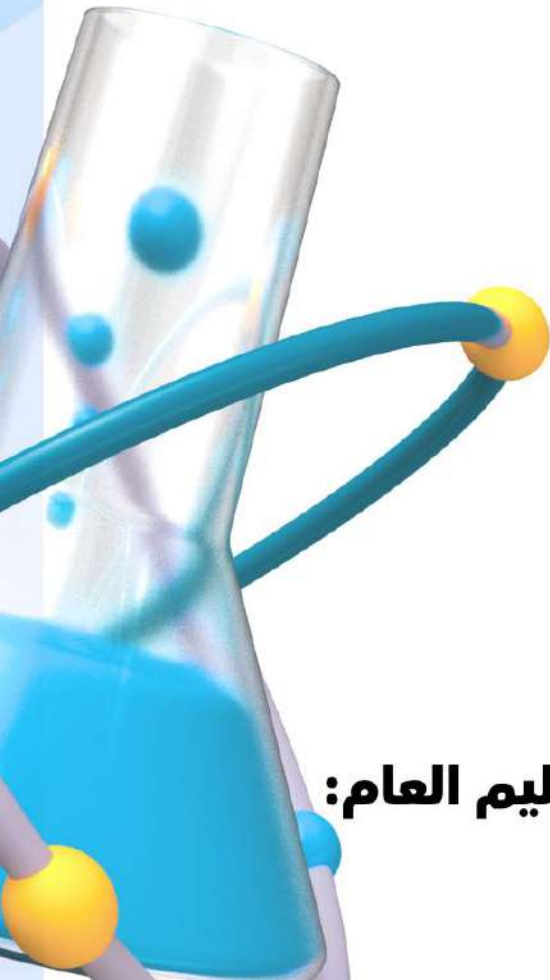
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2026

week

12

Home performance (Week 12)

Q1/ Choose the correct answer:-

1- Which row describes the reactions of zinc oxide?

	Reaction with hydrochloric acid	Reaction with aqueous sodium hydroxide
(a)	✓	✓
(b)	✓	X
(C)	X	✓
(d)	X	X

Reaction occurs = (✓)

Reaction doesn't occur = (X)

2- Which statement are properties of amphoteric oxides

1- React with sodium hydroxide gives sodium salt and water.

2- React with hydrochloric acid gives chloride salt and water

	(1)	(2)
(a)	✓	✓
(b)	✓	X
(C)	X	✓
(d)	X	X

3-Metalloids are characterized by.....

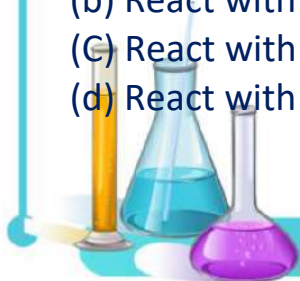
- (a) Valence shell, filled with less than half of its capacity.
- (b) High electro negativity.
- (c) Electric conductivity more than that of the metals.
- (d) The appearance of metals and properties of non-metals.

4- Which of the following oxides is suitable to dry ammonia gas (Basic anhydride) from water vapor?

- (a) Sodium hydroxide
- (b) Phosphorus oxide
- (C) Calcium hydroxide
- (d) Calcium oxide.

5- Which of the following represents nonmetal oxide?

- (a) Dissolve in water forming alkaline solution.
- (b) React with alkalis forming salt and acid.
- (C) React with alkalis forming salt and water.
- (d) React with acids forming salt and water.



6- An element its electronic configuration ended by nP^3 , which of the following correct for the element that follows it in the periodic table?

- (a) Metal has higher electron ability.
- (b) Non-metal has lower ionization energy.
- (c) Non-metal has higher ionization energy.
- (d) Metal has a smaller atomic radius.

7- Zincate salts are used in electroplating (electro galvanization), which can be Prepared by :

- (a) Dissolving zinc metal in acids
- (b) Dissolving zinc oxide in concentrated acids
- (c) Dissolving zinc oxide in strong alkali
- (d) Dissolving zinc oxide in water

8-Aluminum oxide dissolves in sodium hydroxide solution with stirring Because:

- (a) Aluminum $_{13}\text{Al}$ is located in the same period of sodium $_{11}\text{Na}$
- (b) Aluminum oxide reacts as a base with sodium hydroxide
- (c) Basic property decreases in the same period by increasing atomic number.
- (d) Aluminum oxide reacts as an acid with sodium hydroxide.

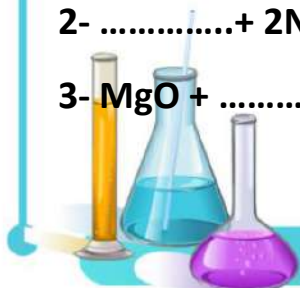
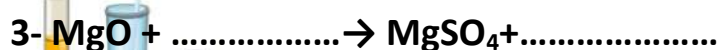
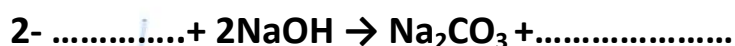
9- All of the following oxides react with potassium hydroxide except.....

- (a) SnO
- (b) P_2O_5
- (c) ZnO
- (d) MgO

10-Which of the following oxides its mixture dissolves in water, it yields a Neutral solution?

- a) Na_2O , K_2O
- b) Na_2O , MgO
- c) Na_2O , P_4O_{10}
- d) SO_3 , P_2O_5

Q2/ Complete the following equations:



Weekly assessment (Week-12)

Question (1):- Choose the correct answer:

(1) Which of the following oxides is suitable to dry carbon dioxide gas?

- (a) Sodium hydroxide
- (b) Phosphorus oxide
- (C) Calcium hydroxide
- (d) Calcium oxide.

(2) Which of the following groups of oxides are all classified as neutral oxides?

- (a) Al_2O_3 , ZnO , SnO
- (b) NO , NO_2 , N_2O_5
- (C) CO , NO , N_2O
- (d) SO_3 , NO , P_2O_5

(3) Which of the following choices represents the location of the strongest metal in the periodic table?

	Left or right side of a period	At the top or bottom of a group
(a)	Left	Bottom
(b)	Left	Top
(C)	right	Bottom
(d)	right	Top

Question (2):- how can you get(By balanced chemical equations)

1- Sodium meta aluminate from sodium oxide

2- potassium zincate from potassium oxide

3- Magnesium sulphate from sulphur trioxide gas

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Question (3):- Give reasons for each of the following:

1-Antimony trioxide is an amphoteric oxide.

.....

.....

2-Aluminum oxide is from amphoteric oxides.

.....

.....

3-The nonmetal oxides are known as acidic oxides.

.....

.....

4-The metal oxides are known as basic oxides

.....

.....

5-Magnesium oxide does not react with sodium hydroxide.

.....

.....

6- The metals are electropositive elements whereas the nonmetals are

.....

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Question (3):- Write Scientific term for each of the following:-:

1- Oxides that do not dissolve in water and do not react with acids or alkalis

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2- Elements used as semiconductors in the manufacture of transistors

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3- The strongest non-metallic element

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حمل الآن

مجاناً وحصرياً

المراجعة رقم (3)

الترم الاول





Choose the correct answer for the questions 1 : 20

20 marks

- 1 The mass of 1.12 L of gas (X) equals 6.23 g (at STP).

What is the molar mass of gas (X) ?

- (a) 56 g/mol (b) 89 g/mol (c) 124.6 g/mol (d) 140.6 g/mol

- 2 Which of the following contains the highest number of molecules ?

- (a) 1 g H_2 (b) 2 g N_2 (c) 4 g O_2 (d) 11 g CO_2
- [H = 1, N = 14, O = 16, C = 12]

- 3 In terms of the hypothetical equation :



On mixing 3 mol of substance (A) with 2 mol of substance (B).

Which of the following represents the limiting reactant ? Why ?

- (a) Substance (A), as its number of moles is higher than that of (B).
(b) Substance (A), as its moles are consumed completely.
(c) Substance (B), as its number of moles is less than that of (A).
(d) Substance (B), as its moles are consumed completely.

- 4 In terms of the reaction : $Fe_{(s)} + 2HCl_{(aq)} \longrightarrow FeCl_{2(aq)} + H_{2(g)}$

What is the mass of iron (II) chloride produced from the reaction of 28 g of iron with excess of hydrochloric acid ?

[Fe = 56, Cl = 35.5]

- (a) 26.5 g (b) 52.5 g (c) 63.5 g (d) 91.5 g

- 5 What is the mass of 3.01×10^{23} atoms of sodium ?

[Na = 23]

- (a) 46 g (b) 23 g (c) 11.5 g (d) 0.5 g

- 6 On burning 50 mL of the hydrocarbon C_xH_y in excess of oxygen gas, 200 mL of carbon dioxide gas and 250 mL of water vapour are formed (at STP).

What is the molecular formula of this hydrocarbon ?

- (a) C_2H_4 (b) C_3H_8 (c) C_4H_8 (d) C_4H_{10}

7 Of which of the following gases 0.25 mol equals 7 g ? [C = 12, H = 1]

- (a) C_2H_6 (b) C_2H_4 (c) C_3H_8 (d) C_3H_6

8 2.31 g sample of one of nitrogen oxides contains nitrogen of a mass equals 0.68 g
What is the empirical formula of this oxide? [N = 14, O = 16]

- (a) NO (b) N_2O (c) NO_2 (d) N_2O_4

9 The combustion of a hydrocarbon yields 2.2 g of CO_2
What is the mass of carbon in this hydrocarbon ? [C = 12, H = 1, O = 16]

- (a) 0.6 g (b) 1.1 g (c) 6 g (d) 8 g

10 2 g of KNO_3 salt (its molar mass is 101 g/mol) are dissolved in a suitable amount of water to form a solution whose volume = 0.5 L

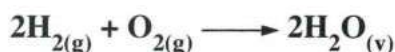
What is the molar concentration of the produced solution ?

- (a) 0.02 M (b) 0.04 M (c) 0.1 M (d) 0.2 M

11 If the formula of antimony oxide is Sb_2O_3 and that of sodium phosphate is Na_3PO_4 , so the formula of antimony phosphate is

- (a) $SbPO_4$ (b) Sb_2PO_4 (c) $Sb_2(PO_4)_3$ (d) Sb_3PO_4

12 10 g of hydrogen gas react with excess oxygen gas according to the equation :



What is the reacted volume of oxygen gas (at STP) and the mass of the produced water vapour from this reaction ? [H = 1, O = 16]

Choices	Reacted volume of O_2	Mass of H_2O
(a)	2.5 L	5 g
(b)	5 L	5 g
(c)	56 L	90 g
(d)	56 L	120 g

13 Which of the following samples has the largest mass ? [N = 14, H = 1]

- (a) 1 mol of N_2H_4 (b) 2 mol of N_2
(c) 3 mol of NH_3 (d) 25 mol of H_2

- 14 The molecular formula of a compound is X_4O_6 , 10 g of this compound contains 5.72 g of the element (X).

What is the relative atomic mass of element (X) ?

[O = 16]

- (a) 32 (b) 37 (c) 42 (d) 98

- 15 What is the volume of water which is required to be added to 0.45 L of 7.5 M solution to change its concentration to 5 M ?

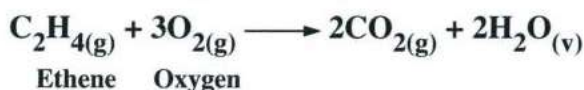
- (a) 0.225 L (b) 0.675 L (c) 0.115 L (d) 0.573 L

- 16 Two samples of oxygen and nitrogen gases have the same volume at the same conditions of pressure and temperature.

What is the similarity between these two gases ?

- (a) The number of the molecules. (b) The number of the ions.
(c) The number of the atoms. (d) The molar mass.

- 17 1 mol of ethene gas burns according to the equation :



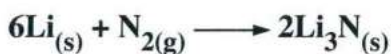
What is the number of the moles of the gases and the vapours which are found at the end of the reaction of 1 mol of ethene gas with 4 mol of oxygen gas ?

- (a) 2 mol (b) 3 mol (c) 4 mol (d) 5 mol

- 18 Which of the following formulas represents an empirical formula ?

- (a) N_2O_4 (b) C_3H_6 (c) NH_3 (d) P_4H_{10}

- 19 In the reaction :



What is the number of moles of lithium required to react with excess of nitrogen gas to produce 0.6 mol of lithium nitride ?

- (a) 0.2 mol (b) 0.3 mol (c) 0.4 mol (d) 1.8 mol

- 20 These are 3 samples of different gases (at rtp) :

- (1) 4 g of argon gas. (2) 3.2 g of oxygen gas.
(3) 4.4 g of carbon dioxide gas.

What is the correct relation between the volumes of these samples of the gases ?

- (a) Volume of sample (1) > Volume of sample (2).
(b) Volume of sample (2) > Volume of sample (3).
(c) Volume of sample (1) = Volume of sample (3).
(d) Volume of sample (3) > Volume of sample (1).

[Ar = 40 , O = 16 , C = 12]

Answer the essay questions 21 : 23

4 marks

- 21 Calculate the mass of ammonia gas NH_3 that has the same volume of 8 g of oxygen gas O_2 (at rtp). [N = 14, H = 1, O = 16]

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1 mark

- 22 From the reaction equation : $2\text{NH}_{3(g)} + 3\text{CuO}_{(s)} \longrightarrow 3\text{Cu}_{(s)} + 3\text{H}_2\text{O}_{(l)} + \text{N}_{2(g)}$

Calculate the volume of ammonia gas (at STP) which reacts completely with 6 g of copper oxide. [Cu = 63.5, O = 16]

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2 marks

- 23 An unknown compound contains 24.2% carbon, 4% hydrogen and the rest is chlorine.

What is the molecular formula of this compound ?

Given that its molar mass is 148.5 g/mol

[C = 12, H = 1, Cl = 35.5]

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1 mark



Choose the correct answer for the questions 1 : 20

20 marks

1 A student has presumed wrongly that the two electrons (X) and (Y) which are in the same atom have the following quantum numbers :

- Electron (X) : $n = 4$, $\ell = 0$, $m_\ell = 0$, $m_s = +\frac{1}{2}$
- Electron (Y) : $n = 4$, $\ell = 0$, $m_\ell = 0$, $m_s = +\frac{1}{2}$

What is the rule or the principle which explains this mistake ?

- (a) Pauli's exclusion principle. (b) Aufbau principle.
(c) Hund's rule. (d) Uncertainty principle.

2 The number of the orbitals of the sublevel which has the two values ($n = 4$, $\ell = 3$) is

- (a) 2
(b) 3
(c) 5
(d) 7

3 What does the opposite figure represent ?

- (a) The structure of helium atom ${}_2\text{He}$
(b) The two electrons of p_x are in a spin-paired state.
(c) The two electrons of the same orbital carry the same charge.
(d) Hund's rule.

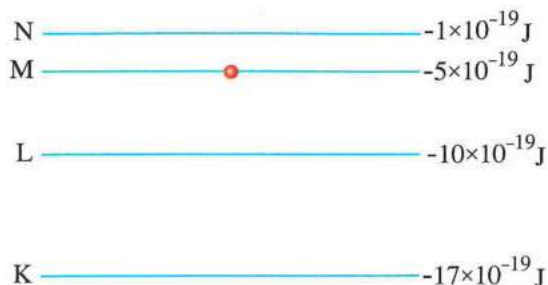


4 What is the atomic number of the element whose level which has the principal quantum number ($n = 3$) contains 13 electrons ?

- (a) 17
(b) 23
(c) 25
(d) 43

- 5 The opposite figure demonstrates the energy levels of a hypothetical atom, if an electron transfers from the energy level M to K, then it

- (a) acquires an amount of energy equals $5 \times 10^{-19} \text{ J}$
 (b) acquires an amount of energy equals $12 \times 10^{-19} \text{ J}$
 (c) loses an amount of energy equals $5 \times 10^{-19} \text{ J}$
 (d) loses an amount of energy equals $12 \times 10^{-19} \text{ J}$



- 6 An electron with the quantum numbers :

$$(n = 4, \ell = 1, m_\ell = -1, m_s = +\frac{1}{2}).$$

What is the sublevel of this electron ?

- (a) 4s (b) 4p (c) 4d (d) 4f

- 7 What is the maximum number of electrons that can have the quantum numbers $(n = 3, \ell = 1, m_\ell = -1)$ in the same atom ?

- (a) $10e^-$
 (b) $6e^-$
 (c) $4e^-$
 (d) $2e^-$

- 8 The electrons of the last energy level in neon $_{10}\text{Ne}$ atom occupy several orbitals which have two different shapes.

Which of the following represents correctly one of these orbitals ?

Choices	Shape of the orbital	Energy of this orbital compared to the other orbitals
(a)		Higher than or equal to them
(b)		Higher than or equal to them
(c)		Lower than or equal to them
(d)		Lower than or equal to them

- 9 The number of the electrons found in the orbitals of s sublevel equals that found in the orbitals of p sublevel in the atom of
- (a) $_{14}\text{Si}$ (b) $_{12}\text{Mg}$ (c) $_{11}\text{Na}$ (d) $_{7}\text{N}$
- 10 On comparing the energy and the charge of the electrons in the energy level L in beryllium Be atom to those of the electrons of the energy level K they are found to have
- (a) lower energy but the same charge. (b) higher energy but the same charge.
(c) lower energy but the same (n) value. (d) higher energy but the same (n) value.
- 11 Which of the following electronic configurations violates Aufbau principle ?
- (a)  (b) 
- (c)  (d) 
- 12 Which of the following sets of quantum numbers expresses the electron of an excited hydrogen atom ?
- (a) $n = 4$, $l = 3$, $m_l = -3$ (b) $n = 4$, $l = 4$, $m_l = -2$
(c) $n = 5$, $l = -1$, $m_l = +2$ (d) $n = 3$, $l = 1$, $m_l = -2$
- 13 What is the maximum number of electrons in an atom which has the two quantum numbers ($n = 4$, $l = 1$) ?
- (a) 2 (b) 6 (c) 8 (d) 10
- 14 What is the correct order of the orbitals in titanium $_{22}\text{Ti}$ atom according to the increase of energy ?
- (a) $3s < 3p < 3d < 4s$ (b) $3s < 3p < 4s < 3d$
(c) $3s < 4s < 3p < 3d$ (d) $4s < 3s < 3p < 3d$
- 15 Which of the following electronic configurations represents the ground state of an atom that contains 8 electrons ?
- (a)  (b) 
- (c)  (d) 

16 What is the atomic number of the atom of the element whose orbitals contain 3 unpaired electrons ?

- (a) 5 (b) 13
(c) 15 (d) 21

17 Which of the following transfers in hydrogen atom produces the largest quantum of energy ?

- (a) $(n = 7) \longrightarrow (n = 6)$ (b) $(n = 6) \longrightarrow (n = 5)$
(c) $(n = 4) \longrightarrow (n = 3)$ (d) $(n = 2) \longrightarrow (n = 1)$

18 Which of the following represents the electronic configuration of an excited phosphorus atom ?

- (a) $1s^2, 2s^2, 2p^6, 3s^2, 3p^3$ (b) $1s^2, 2s^2, 2p^6, 3s^2, 3p_x^1, 3p_y^1, 3p_z^1$
(c) $1s^2, 2s^2, 2p^6, 3s^2, 3p^2, 4s^1$ (d) $1s^2, 2s^2, 2p^6, 3s^2, 3p$ 

19 Among the modifications introduced by the modern atomic theory to the older theories is

- (a) it is impossible to determine both the position and speed of the 11^{th} electron in ${}_{11}\text{Na}$ atom precisely at the same time.
(b) the electron is negatively charged.
(c) most of the atomic volume is an empty space.
(d) the spaces between energy levels are forbidden for the electrons.

20 The opposite electronic configuration violates

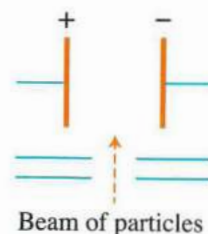


- (a) Aufbau principle only.
(b) Pauli's exclusion principle only.
(c) Hund's rule only.
(d) Pauli's principle and Hund's rule.

Answer the essay questions 21 : 23

4 marks

- 21 The scientists discovered the presence of the electrons, protons and neutrons in the atom during the centuries 19 and 20, if a beam of each of them is passed through an electric field (as in the opposite figure).



In which direction will the deflection be ? Explain.

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2 marks

- 22 Compare between Thomson's atomic model and Rutherford's atomic model in 2 points only.

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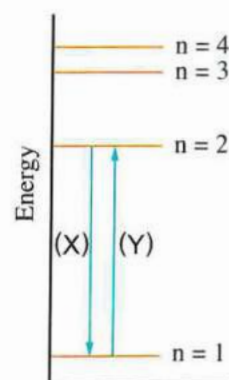
2 marks

- 23 In the opposite figure :

Which of the two processes

(X) and (Y) requires losing energy ?

What is the scientific term of this amount of energy in the light of Bohr's theory ?



1 mark

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Choose the correct answer for the questions 1 : 20

20 marks



1 Each of the following statements shows the correct graduation of the mentioned property in the representative elements, except

- (a) first ionization potential (${}_7\text{N} < {}_8\text{O} < {}_9\text{F} < {}_{10}\text{Ne}$).
- (b) ionic radius (${}_8\text{O}^{2-} < {}_{16}\text{S}^{2-} < {}_9\text{F}^- < {}_{11}\text{Na}^+$).
- (c) acidic property ($\text{HF} < \text{HCl} < \text{HBr} < \text{HI}$).
- (d) the oxidation number of oxygen ($\text{MgO} < \text{Na}_2\text{O}_2 < \text{KO}_2 < \text{OF}_2$)

2 Which of the following oxides react together when dissolved in water ?

- (a) Al_2O_3 , ZnO
- (b) Na_2O , MgO
- (c) Na_2O , P_2O_5
- (d) SO_3 , P_2O_5

3 Which of the following is correct ?

Choices	Reactants	Ionic equation
(a)	H_2SO_4 , K_2CO_3	$2\text{K}^+_{(\text{aq})} + \text{SO}_4^{2-}_{(\text{aq})} \longrightarrow \text{K}_2\text{SO}_{4(\text{aq})}$
(b)	H_2SO_4 , K_2CO_3	$\text{K}_2\text{CO}_{3(\text{s})} + 2\text{H}^+_{(\text{aq})} \longrightarrow \text{CO}_{2(\text{g})} + \text{H}_2\text{O}_{(\text{l})} + 2\text{K}^+_{(\text{aq})}$
(c)	H_2SO_4 , KOH	$\text{OH}^-_{(\text{aq})} + \text{H}^+_{(\text{aq})} \longrightarrow \text{H}_2\text{O}_{(\text{l})}$
(d)	H_2SO_4 , KOH	$2\text{KOH}_{(\text{s})} + 2\text{H}^+_{(\text{aq})} + \text{SO}_4^{2-}_{(\text{aq})} \longrightarrow 2\text{H}_2\text{O}_{(\text{l})} + \text{K}_2\text{SO}_{4(\text{aq})}$

4 In the second period, on moving from lithium to fluorine,

- (a) the atomic size decreases.
- (b) the ionization potential decreases.
- (c) the electronegativity decreases.
- (d) the nuclear charge decreases.

- 5 The following table exhibits the electron configurations of 4 different elements :

$[\text{Ar}], 3d^{10}, 4s^1$	$[\text{Kr}], 5s^2, 4d^{10}, 5p^6, 6s^2$
$[\text{Xe}], 6s^2, 4f^{14}, 5d^{10}, 6p^6, 7s^1$	$[\text{Xe}], 4f^{14}, 5d^1, 6s^2$

What is the number of the elements which are located in s-block ?

- (a) 1 (b) 2
(c) 3 (d) 4

- 6 In which of the following is the summation of the two oxidation numbers of manganese and nitrogen – each in its substance – the least ?

Choices	Manganese substance	Nitrogen substance
(a)	MnCl_4	N_2
(b)	MnCO_3	NO_2^-
(c)	K_2MnO_4	NH_4^+
(d)	$\text{Mn}(\text{OH})_3$	NH_2OH

- 7 Which of the following statements is correct ?

- (a) The element with the atomic number 80 is located in the 6th period, group (1B).
(b) The element with the atomic number 38 is located in the 6th period, group (2B).
(c) The element with the electronic configuration : $[\text{Xe}], 4f^{14}, 5d^5, 6s^2$ is located in 6th period, group (7B).
(d) The element with the electronic configuration : $[\text{Ar}], 3d^{10}, 4s^2, 4p^4$ is located in 4th period, group (6B).

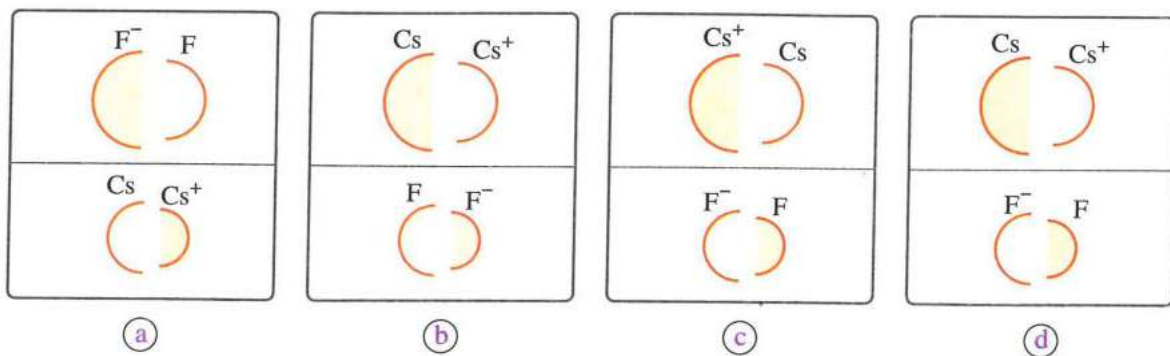
- 8 What are the two metals whose oxides can react with both acids and alkalis ?

- (a) Na, Zn (b) Mg, Al
(c) Mg, Be (d) Al, Zn

- 9 Which of the following represents the proper graduation of the electronegativities of the elements (${}_4\text{X} / {}_{12}\text{Y} / {}_{15}\text{Z} / {}_{19}\text{M}$) ?

- (a) $\text{Y} < \text{X} < \text{Z} < \text{M}$ (b) $\text{M} < \text{Z} < \text{Y} < \text{X}$
(c) $\text{X} < \text{Z} < \text{Y} < \text{M}$ (d) $\text{M} < \text{Y} < \text{X} < \text{Z}$

- 10 Which of the following represents the correct relation between the atomic radius and ionic radius ?



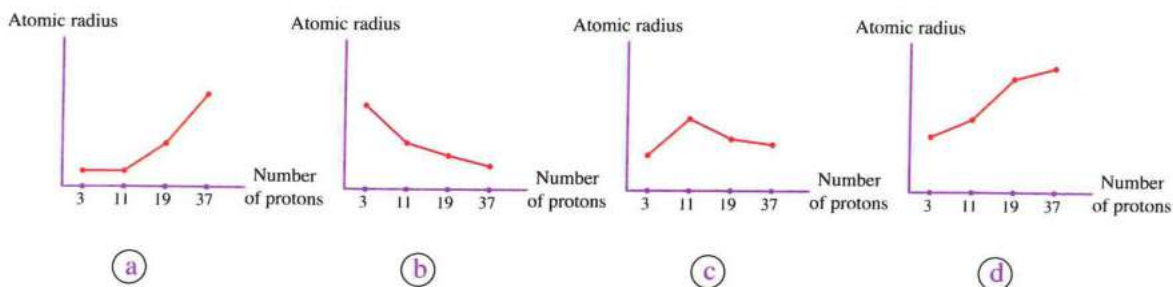
- 11 Which of the following statements is correct ?

- (a) Lanthanum $_{57}\text{La}$ and actinium $_{89}\text{Ac}$ do not belong to lanthanides and actinides.
 (b) The element whose atomic number is 31 is located in the third period.
 (c) The electron configuration of $_{27}\text{Co}$ does not follow the system : $ns^{1:2}, (n-1)d^{1:10}$
 (d) All actinides have stable nuclei.

- 12 Element (X) is located in the fourth period, group (15) in the modern periodic table. Which of the following represents the electron configuration of the last energy level in its atom ?

- (a) d orbitals are half filled and s orbital is completely filled.
 (b) s orbital is completely filled and p orbitals are half filled.
 (c) d orbitals are occupied by electrons and s orbital is half filled.
 (d) p orbitals are half filled and s orbital is half filled.

- 13 Which of the following graphical figures represents the graduation of the atomic radii of the elements of group (1A) ?



- 14 The opposite table shows the first five ionization potentials of the element (X).

Ionization potential (kJ/mol)				
First	Second	Third	Fourth	Fifth
+738	+1451	+7733	+10541	+13629

What is the number of the group of the element (X) in the modern periodic table ?

- (a) 1 (b) 2
(c) 13 (d) 14
- 15 What is the oxidizing agent in the reaction : $\text{Cu} + 2\text{Ag}^+ \longrightarrow \text{Cu}^{2+} + 2\text{Ag}$?

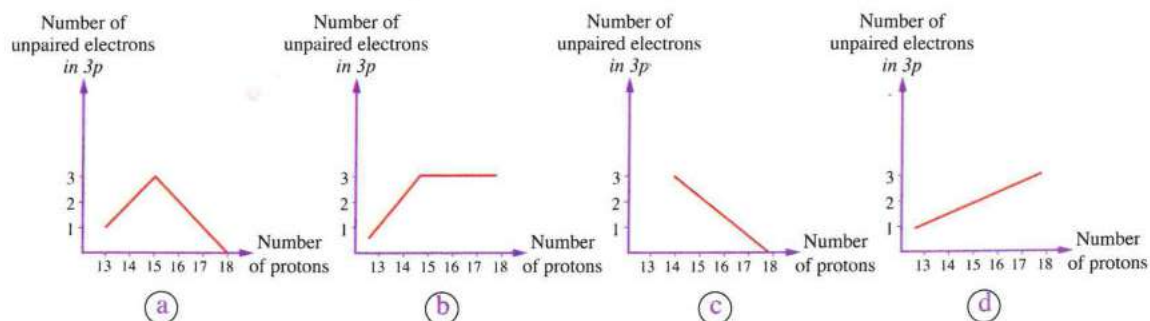
- (a) Cu (b) Ag^+
(c) Cu^{2+} (d) Ag

- 16 In the reaction : $3\text{NaClO} \xrightarrow{\Delta} 2\text{NaCl} + \text{NaClO}_3$

Which of the following choices represents the oxidation numbers of chlorine in the three compounds ?

Choices	NaClO	NaCl	NaClO ₃
(a)	-1	-1	+5
(b)	+1	-1	+5
(c)	+1	-1	+7
(d)	+2	+1	+7

- 17 Which of the following graphical figures represents the number of the unpaired electrons in the orbitals of $3p$ sublevel in the elements of the third period in the periodic table ?



18 In the following equations :



Which of the following equations represents the second ionization potential of sodium ?

(a) $x + w$

(b) $x - w$

(c) $y + w$

(d) $z - y$

19 The electronic configuration : $[\text{Xe}] , 6s^2 , 5d^{10} , 4f^{14} , 6p^3$

represents

(a) an inner transition element.

(b) a main transition element.

(c) a representative element.

(d) a noble element.

20 (1) : Number of protons in Mg^{2+} is higher than that in Al^{3+}

(2) : Number of neutrons in each of Mg^{2+} and Al^{3+} is higher than the number of protons in each of them.

(3) : The electronic configurations of Mg^{2+} and Al^{3+} are similar.

(4) : Numbers of neutrons in both of Mg^{2+} and Al^{3+} are equal.

Which of these statements represent ${}_{13}^{27}\text{Al}^{3+}$ and ${}_{12}^{26}\text{Mg}^{2+}$ ions ?

(a) (1) and (2) only.

(b) (1) and (3) only.

(c) (3) and (4) only.

(d) (2) , (3) and (4).

Answer the essay questions 21 : 23

4 marks

21 Write the overall equation and the net ionic equation of the reaction :



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1 mark

22 Identify each of the oxidation and the reduction in the reaction :



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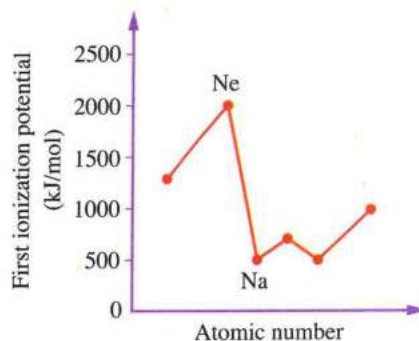
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1 mark

23 The opposite figure represents

the first ionization potentials of some elements of the second and the third periods.

Why is the first ionization potential of neon higher than that of sodium ?



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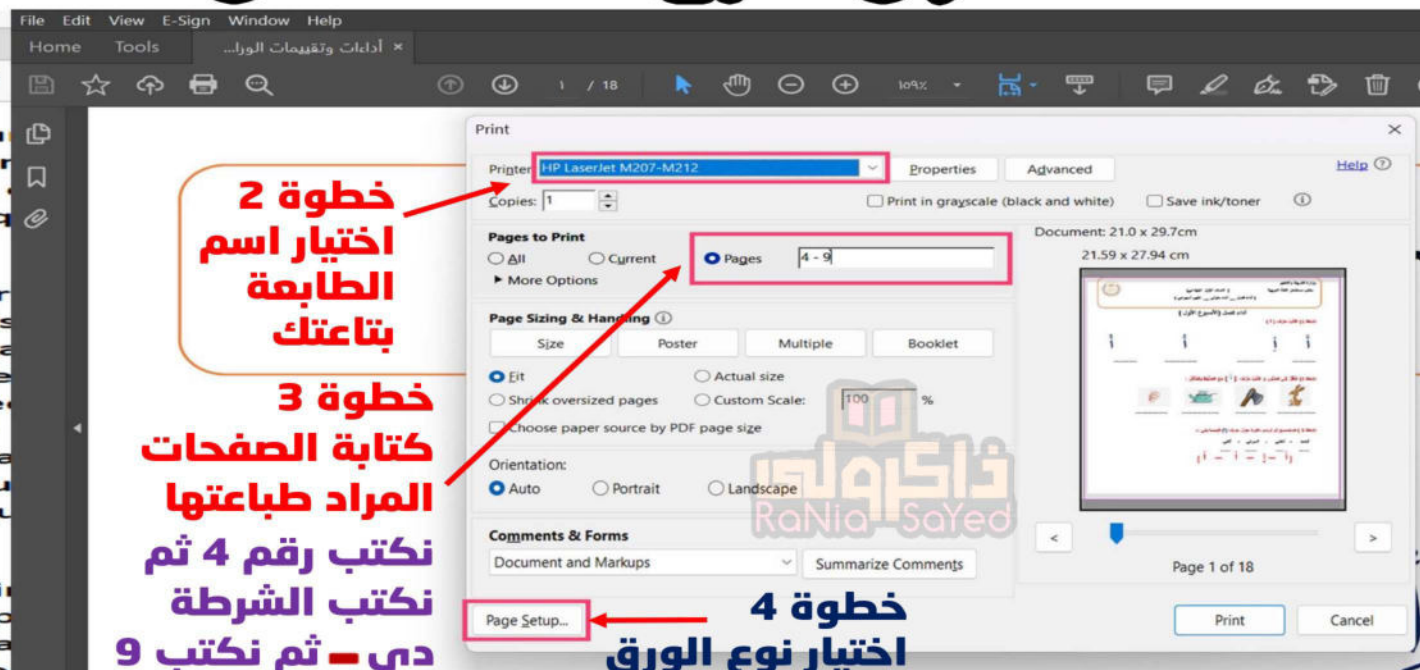
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2 marks

كيفية طباعة صفحات معينة من ملف معين مثلا ازاي نطبع الصفحات من صفحة 4 الى صفحة 9



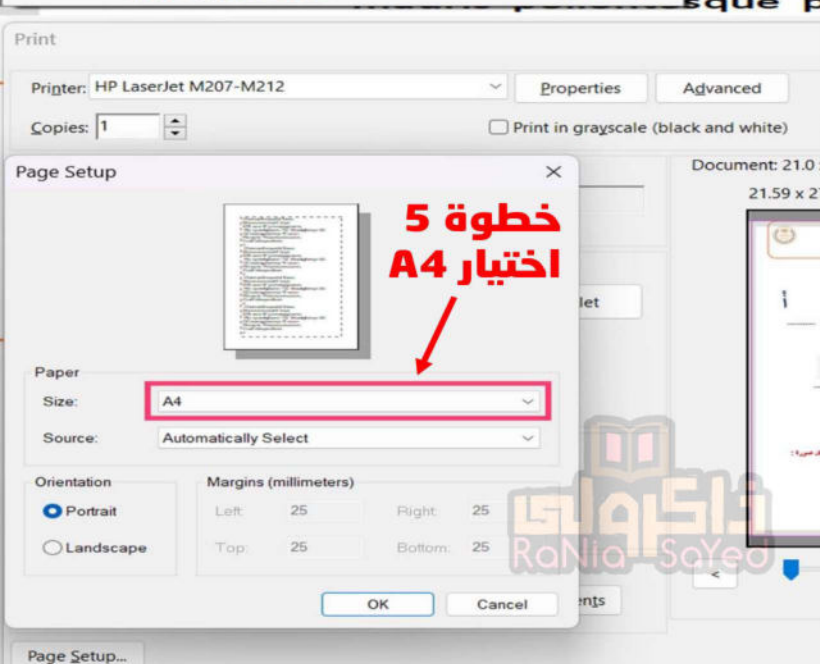
خطوة 1



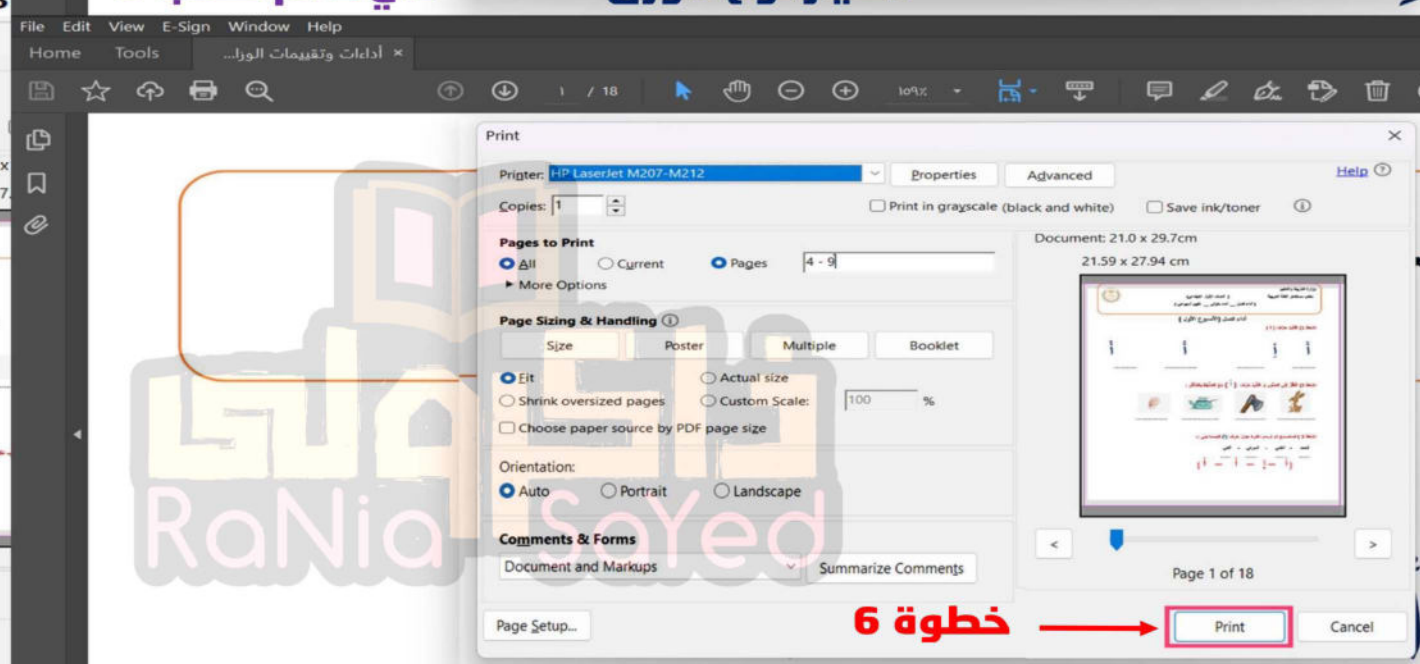
خطوة 2
اختيار اسم
الطابعة
بتاعتك

خطوة 3
كتابة الصفحات
المراد طباعتها
نكتب رقم 4 ثم
نكتب الشرطة
دي - ثم نكتب 9

خطوة 4
اختيار نوع الورق



خطوة 5
اختيار A4



خطوة 6